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THE MANUFACTURER AND BUILDER.

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Knowles' Improved Independent Air Pump and Condenser.

The following description and illustrations relate to a notable improvement in the construction of independent air pumps and condensers designed and constructed by the Knowles Steam Pump Works. Many objections have been urged against the use of connected air pumps, such, for example, as the necessity of making the air pump of much larger capacity than is actually required ordinarily, in order to insure a good vacuum under all circumstances; and the impossibility of regulating its speed when connected, in accordance with the varying load on the engine, so as to secure the most economical results, both of which elements involve a material loss of power. These objections have been measurably removed by certain forms of independent condensing apparatus that have been devised, but none of them appear to have met the difficulties of the problem so practically and effectually as that herewith described.

By consulting Fig. 1, the Knowles independent air pump and condenser will be seen in position attached to the engine; and in Fig. 2, with a portion of the side of the condenser removed, to show its internal construction. In this apparatus it is obvious that the considerable friction involved in the operation of the pump, through the intervention of bell crank or lever connections is obviated with corresponding economy in operation. The steam end of the pump here shown is of the improved Knowles design lately described in the MANUFACTURER AND BUILDER, the air pump in this case taking the place of the water cylinder. The dimensions are, steam cylinder, 8 inches diameter; and air cylinder, 12 inches diameter, with 12-inch stroke.

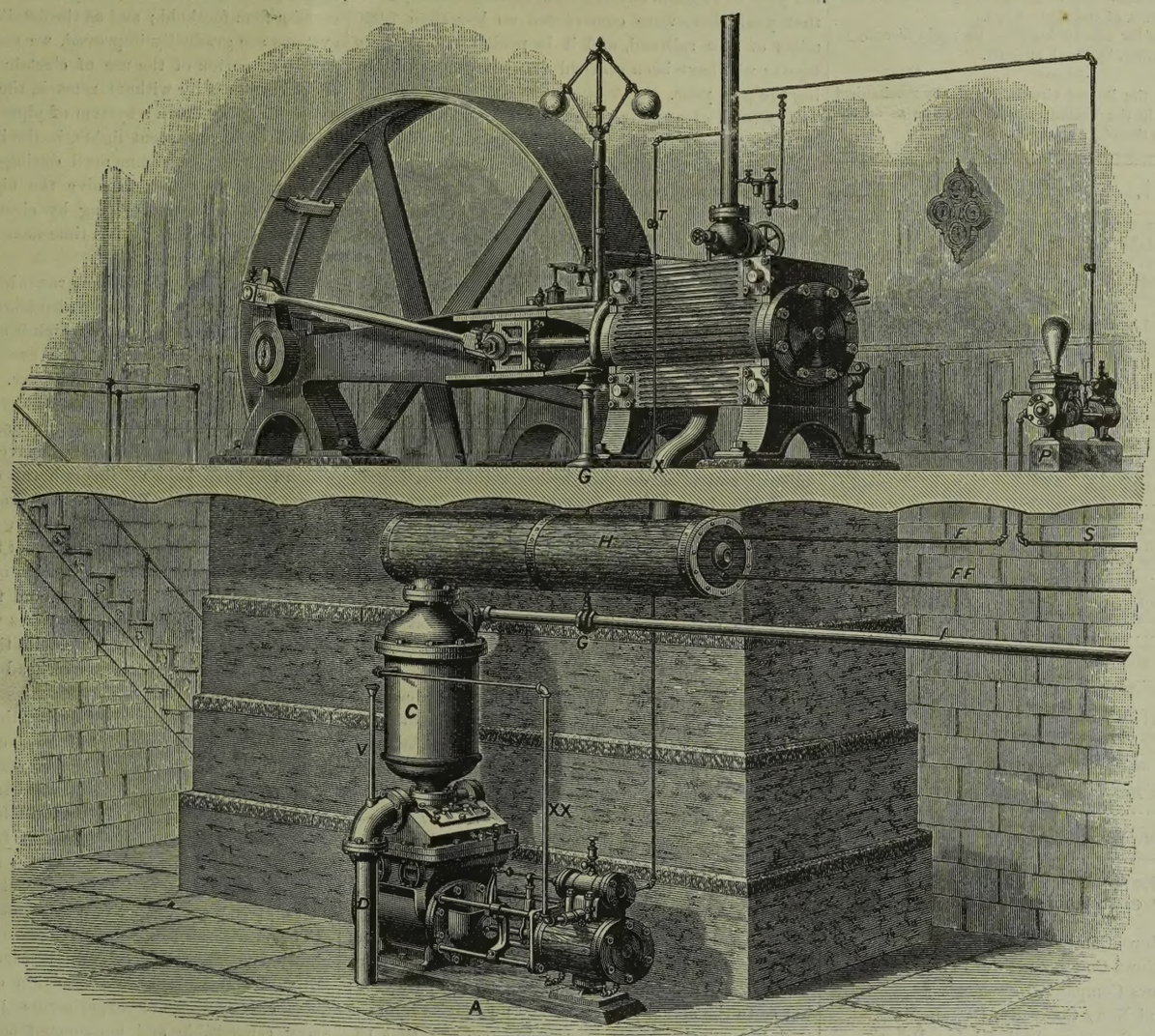

Fig. 1.—KNOWLES' IMPROVED INDEPENDENT AIR PUMP AND CONDENSER ATTACHED TO ENGINE.

By consulting Fig. 1, which shows the independent air pump and condenser, with a heater, attached to a high-speed automatic cut-off engine, the several parts and their relations will be readily understood from the following brief description: A represents the air pump placed by the side of the engine foundation; C, the condenser; D, the discharge pipe; X X, exhaust pipe from steam cylinder of air pump to condenser; and V, the vapor discharge pipe of air pump. A surface coil heater H is placed between the cylinder of the main engine and the condenser, being located as near to the former as possible, in order to get the full benefit of the hot exhaust steam from the pipe X for heating the feed-water. The feed-water is drawn through the suction pipe S and is forced by the pump P through the pipe F to the heater, where it circulates through a long coil, thence through the feed pipe F F to the boiler. It is unnecessary for the engineer to descend to the air pump in order to start and stop it, for steam may be readily admitted or shut off by means of the valve T within his reach. It is considered more economical to pump cold water into the heater rather than to feed from a hot well, for the reason that the cold water, in passing through the coil, helps to condense the steam, and gives the condenser and air pump less to do. By this arrangement the extra connections, expense and room occupied by a tank for hot water are avoided. The water taken from the heater is hotter than if taken from a hot well or tank, as the hot steam, upon leaving the engine cylinder, immediately

(*Continued on page* 4.)

The Manufacturer and Builder.

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1881.

The year just passed was not made memorable by any remarkable discovery or invention that will serve to distinguish it notably in the future, but rather by a steady and satisfactory advance in many of the arts and sciences, and by a degree of general industrial activity and business prosperity that has rarely been surpassed. These stimulating conditions have sent their vivifying influences over the whole world; but nowhere have they been more strongly felt than in our own country. We give in the following a brief *resumé* of the more important and interesting items respecting the scientific, industrial and engineering progress of the past year, beginning our summary with the last named.

In this country, the most notable fact in engineering during the past year has been the great and almost unparalleled extension of our railway system, which, though quite remarkable in 1880, was considerably surpassed in 1881. The mileage of new roads completed in 1881 will not fall far short of that of 1873, which has up to this time been looked upon as the phenomenal year in railroad construction in this country. In that year there were constructed no less than 7,000 miles of new railroad, and it is probable that these figures will have been reached or even surpassed during the past year.

The work of removing the obstructions to the navigation of New York harbor, existing at Flood Rock, has been steadily pushed forward during the year, and considerable progress in the excavation of galleries in the reef has been made. The work is in charge of the government engineers, who some years ago so signally succeeded in the task of removing the formidable reef at Hallet's Point. Next in importance to this, we may estimate the Hudson River tunnel, which was commenced in 1880. During the past year work on the tunnel has been advanced very satisfactorily, and without serious accident or loss of life. The task of finishing the East River bridge, which many residents of the metropolis have despaired of living to witness, has been slowly advanced. The approaches have been finished, and work on the superstructure was begun. The original plans of the constructors have been somewhat modified, by making the bridge five feet wider and four feet higher above the river, besides considerably increasing its strength. At present nearly all the floor beams have been laid. If nothing new intervenes, we may seriously hope to see this great structure finished and open for traffic in another year or two.

An ambitious project which contemplates the drainage of the Florida everglades and the reclamation of vast tracts of swamp land to agriculture, has been set on foot during the past year. The project is in the hands of a strong corporation, and from present appearances will be earnestly undertaken. The claim is made that the work of drainage can be easily accomplished, and that when finished, many millions of acres of highly fertile land will be reclaimed.

Turning our attention to Lesseps' project for cutting a ship canal across the Isthmus of Panama, to connect the waters of the two oceans, we may note that work was actually commenced upon it during the past year; but as to the actual progress made no definite information has appeared. It is certain, however, that the deadly character of the climate has told terribly upon the staff of engineers and other European employees, many of whom have died. The Tehuantepec ship railway project of Capt. Eads, concerning which at one time such sanguine expectations were entertained, attracted but little attention during the past year, no movement apparently having been made by its projector.

Turning to Europe, we may record as an event of the year 1881, the formal opening of the St. Gothard railway and tunnel to traffic, thus signalizing the final completion of that gigantic undertaking. The projectors of that still more ambitious undertaking—the English Channel tunnel—have continued their preliminary work of drifting an exploration tunnel, and it looks as though this project would really be seriously undertaken.

Considerable interest has been excited during the past year by the undertaking of an important extension of the plan of heating cities and towns by means of steam distributed through the streets from central stations. This plan, which is known as the Holly system, and which has been in use in Lockport, N. Y., and other places of lesser note, is being introduced into a section of this city by consent of the authorities, the laying of pipes, etc., having been commenced during the past year.

We may notice a decided advance in the introduction and efficiency of the several plans of electric lighting during the past year. The electric light is now very generally introduced in our cities and towns, both for street illumination and private purposes. The most notable experiments of this kind inaugurated during the past year, were the lighting of considerable portions of Broadway and Fifth avenue, New York, and of Chestnut street, Philadelphia. The decided advantages of the electric light have come to be so generally acknowledged, that there can be no question that it has secured a firm foothold; and as the details of the several systems are gradually improved, we may look for the steady extension of the use of electric lighting. We should not pass by without remark, the fact that the work of laying down a system of pipes for the trial of the Edison incandescent lights, in the lower section of this city, was also commenced during the past year. This system promises to solve the highly important problem of domestic lighting by electricity, and we trust we may be able by this time next year to chronicle its entire success.

While the electric light has grown into public favor during the past year, we have also learned much concerning the conditions under which it should be used, and of the precautions that are necessary to guard against the dangers incident to its use.

The subject of underground telegraphy attracted more or less attention during the past year, chiefly through the persistent advocacy in favor of this reform which has been kept up through the columns of the MANUFACTURER AND BUILDER. Several experimental lines of such buried wires have been laid down, and may be regarded as the forerunners of the change that is to come. The rapid multiplication of the telegraph and telephone wires in our cities, and the dangers incident to the crossing of such wires with those employed for electric lighting, must in time render the maintenance of the present overhead lines quite impossible.

Much interest was aroused during the past year by the substantial improvement of the so-called secondary batteries, by which the problem of storing electricity has been materially advanced toward satisfactory solution. It is highly probable that the further improvement of these forms of batteries will furnish what has long been wanted—namely, a cheap and convenient mode of generating and employing electricity to furnish motive power, especially for domestic purposes.

The year 1881 also witnessed the continuation of the highly ingenious and original researches of Messrs. Bell and Taintor into the production of sound by radiant energy. Their experiments have developed many remarkable and unexpected facts, which have extended the scope of their observations far beyond the production of the photophone, which we recorded in our summary for the year 1880. They have succeeded, among other things, in demonstrating that almost every form of matter is capable of producing audible sounds when submitted to the action of an intermittent beam of light. Thus far these highly original researches have borne no practical fruit, but their useful application is unquestionably merely a question of time.

The electrical exhibition held in Paris during the past year, did much to forward the useful applications of electricity. It was by far the most important and extensive exhibition of electrical apparatus and appli-

ances ever held. We should not omit, also to record the continued success of the electric railway of Siemens in Berlin, which, by the way, was duplicated satisfactorily on a small scale at the Paris Electrical Exhibition. Nor should we pass by without mention the singular and highly suggestive experiments of Dr. Siemens respecting the influence of the electric light upon the growth and development of plants, which seem to have demonstrated that the electric light may in time come to be an important aid to the horticulturist in rendering him independent of climate and season.

Though the year 1881 did not witness any noteworthy improvement in the mode of producing or employing fuel gas, nevertheless we may record with satisfaction the considerable extension of its introduction. The town of Yonkers, N. Y., was supplied during the past year with fuel gas (water gas made by the Strong system) through a separate line of pipes laid down for the purpose, and it is now very generally in use there for heating and domestic purposes. The town of Pullman, Ill., was also supplied with fuel gas generated on the Lowe system; and steps have been taken to introduce fuel gas on an extensive scale in St. Louis; the preliminaries looking to this end have already been taken, and the work will probably be under way next year. These facts are the straws that show wise men which way the wind blows. They point unmistakably to the gradual appreciation on the part of the public of the merits and advantages of gaseous fuel for heating and cooking.

The one great discovery that will serve to distinguish the year 1881, is that of Pasteur, the great French chemist, of a method of mitigating the malignity of the virus of certain fatal contagious diseases among domestic animals, which diseases have hitherto defied all curative treatment. Pasteur has demonstrated by these brilliant and convincing experiments that he has succeeded in effectually controlling these virulent diseases. He has been able, by subjecting the virus of the disease to certain processes, to so modify it, that when introduced into the bodies of healthy animals—as in vaccinating the human subject—it produces but a temporary indisposition, and thereafter renders the inoculated animal effectively proof against the disease. The enormous money value of this great discovery to the agriculturists of Europe, who have been great losers by the ravages of disease among their flocks and herds, is admitted. But still more valuable results may, and probably will, flow from it by the extension of the discoverer's method to the protection of the human subject against many malignant and fatal diseases that afflict the human kind.

In the industrial arts we may not record any brilliant invention to the credit of the year 1881, but the activity and prosperity of all branches of business has been most gratifying, and the year will be looked back upon as a fortunate one by all who are engaged in industrial pursuits. The production of coal and iron during the year 1881 exceeded that of any previous year in our history, and these great industries give us the key-note to the general condition of the country. Incidently we may allude to the enormous extension and present magnitude of the manufacture of glucose. There are now about 25 glucose factories in the United States, which consume no less than 12,000,000, and probably nearer 15,000,000, bushels of corn annually. The enormous production of this material does not seem to be able to keep pace with its increasing consumption, and additional factories are springing into existence every year. Our syrup (molasses) manufacturers, candy makers and brewers could tell us what becomes of the material, if they felt disposed.

We regret that we are unable to record any substantial advance in the production of sugar from the beet in this country during the past year. This is one of the great industries that must sooner or later be domesticated with us, and there is something very discouraging in the slowness with which it progresses. We trust that next year may enable us to record better news in this particular.

During the past year, the German chemist, Baeyer, has made important improvements in the method of producing indigo by artificial means, the possibility of doing which, he was the first to demonstrate, some years ago. He has patented several processes for producing this important dyestuff on a commercial scale, and it is not asserting too much to say that the question of competition of the artificial with the natural product is only one of a little time. In a few years more the industry of producing indigo will have to go the way of the madder cultivation; the last named, which was for centuries an important agricultural industry in France and Germany, has now entirely disappeared, having been destroyed by the cheaper processes of producing the coloring principle of madder from coal tar.

Among the interesting industrial novelties prominently brought out during the past year, we may mention a method of producing lumber from straw, that promises to be important; and the considerable improvement in the method of manufacturing luminous or phosphorescent paint by Mr. Balmain, an English inventor. Finally, it may turn out that chemistry has been enriched by the discovery of another new element, called by its discoverer—Dr. Phipson—actinium. Although at the time of this writing the genuineness of the discovery seems to be highly probable, it has not yet been definitely assured.

With this brief summary, we pay our indebtedness to the year 1881. We trust our summary for 1882 may afford us as much cause for satisfaction.

Dangers of Electric Lighting.

We devote somewhat more than our usual allotment of space this month to a single subject, by the publication of the report of a committee of the Franklin Institute on the precautions to be taken to obviate the dangers that may arise from systems of electric lighting. The report of the committee is a very timely one, since the subject they consider is one which is attracting widespread attention, and because also not a little uneasiness and alarm is felt by many who have hitherto been warm advocates of electric lighting, from the occurrence of serious accidents to person and property through its use. In view of these facts, and of the high reputation of the Franklin Institute, the report of this committee will be widely read. Furthermore, the users of the electric light, the companies engaged in its introduction, and that portion of the public that is especially interested in the progress of the arts, naturally expect, from the eminent scientific and utilitarian reputation of the Institute, to find in this report the most reliable statement of the dangers to be apprehended from the use of the electric light, and the soundest advice as to the means to be employed to avoid them.

In respect to the first portion of this proposition, namely, the accurate statement of the nature of the dangers to be apprehended, the report will be pronounced to be thorough and satisfactory. With respect to the second, however, it is somewhat disappointing. The committee, it is true, state in a general way the nature of the precautions to be taken to guard against danger to person and property, but in some points their report is not specific enough to be of much service, especially to those using the electric light and to those engaged in its introduction. It would have been more satisfactory, for example, if the report had specified the best and most approved methods of insulating the conducting wires, and the size of conducting wire for currents of given powers. With reference to both of these points, the committee simply state in a general way that the conducting wires should be "suitably" insulated throughout their entire length, and that they should be "of sufficient size" to carry the most powerful current employed, without dangerous heating. The manufacturers and users of electric lights do not require to be told these facts; they are already well known. But who is to tell in each case if the wires *are* "suitably" insulated, or if the wires *are* large enough to carry the most powerful current? It is to be regretted that the committee did not make the attempt to establish rules for these conditions by suitable experiments. The absence of just this specific information that we require, is the reason for our criticism of the committee's report. If we are to allow the electric light companies to go ahead as they think best, until they have learned these facts by experimenting, the utility of the committee's report is very questionable.

Again, we find no reference in the committee's report to two precautions which we regard as imperative if the electric light is to be freed from danger. One is the insulation of electric light conductors from all possibility of crossing with telephone and telegraph wires, and like dangers, by carrying them in separate conduits under ground; and the second is the provision of shunts or "cut-offs" at each house, by which the current entering the house can, in case of fire, be shut off from the outside of the building.

While the report may be pronounced good enough so far as it goes, it does not go far enough. A glance at the names signed to the report will reveal the presence on the committee of gentlemen of acknowledged scientific eminence, some of whom are distinguished in this special branch of science. We do not think they have done either the subject or themselves justice in this report.

The Dephosphorizing Process an American Invention.

By a recent decision of the Commissioner of Patents of the United States, the priority of invention in what is known as the basic process for dephosphorizing iron, concerning which numerous references will be found in the back numbers of the Manufacturer and Builder, has been awarded to an American inventor, Mr. Jacob Reese, of Pittsburgh, Pa. This decision will attract widespread attention and discussion, from the importance of the interests that will be affected by it.

The basic process, by making available for the production of steel, pig irons high in phosphorus, which have hitherto been quite useless, promises to immensely extend the utility of the Bessemer process, and many metallurgists have not hesitated to pronounce it to be, next to the Bessemer process itself, the most important discovery in siderurgy of modern times.

The decision above referred to will not only deprive Messrs. Thomas & Gilchrist, the English metallurgists who have hitherto received the credit of the invention, of their rights to ownership in it in this country, but will also, very likely, give rise to serious complications of a business nature, from the fact that a "syndicate" of American Bessemer steel manufacturers have already purchased for a large sum the right to use the Thomas-Gilchrist patents, the most important of which have now been declared invalid. The effect of the decision on the introduction of the basic process here, will only be developed by time. Meantime, Mr. Reese, who has come victoriously out of a severe struggle for his rights, is to be congratulated for his victory, won in the face of the severest opposition and discouragement.

As a significant fact in connection with Mr. Reese's present position, it is said that, when, at the meeting of the American Institute of Mining Engineers, in May, 1879, at which Prof. Maynard read a paper giving the first description of the Thomas-Gilchrist process, Mr. Reese arose and laid claim to having been the prior inventor of the process, his remarks were received with general mirthfulness. His victory in the face of this notable evidence of incredulity is all the more creditable to him.

Oyster Culture.—By planting oysters in various depths of water, and thus securing considerable variations of temperature, it is claimed that the time of spawning can be so modified as to render supplies of this popular article of food available for the entire year, and in first rate condition.

enters the heater. Another very important advantage of this system, is that the oil and dirt from inside the cylinder are prevented from entering the boiler with the feed-water, as the two do not come in contact.

Consulting Fig. 2, the construction of the apparatus will be readily understood. The connection of the exhaust pipe from the main engine is made at the side of the condenser near the top.

The vapor and water are drawn through the spray plate (seen in the engraving) to the pump, the water being discharged through the discharge pipe at the side of the pump, while the vapor escapes through the vapor pipe at the top. The exhaust steam of the pump is likewise led by an exhaust pipe into the condenser, so that the advantages of the vacuum are also there utilized.

It will readily be perceived by those who have read the foregoing, that the speed of this air pump can be regulated and adjusted with great ease, as may be found desirable, according to the temperature of the injection water, or to suit the varying load upon the main engine, an important advantage in point of economy over connected air pumps. In addition to this economy of operation, the saving is excessive water consumption which the apparatus effects, since it permits of the use of the smallest possible quantity of water to condense the steam.

The apparatus is very easily applied to any non-condensing steam engine, with the result of increasing the power from 25 to 30 per cent, or, when additional power is not required, showing a corresponding saving of fuel. It has the additional advantage, that, having no mechanical connection with the main engine, it can be operated independently and a vacuum formed for the engine before it is started; at the same time the pump may be run continuously for maintaining the vacuum, while the steam engine may be stopped and started independently without regard to the air pump. The power necessary to run this machine is affirmed to be about one-half of that usually consumed by the best type of connected air pumps. An important feature of the independent condensing apparatus, that must commend itself to steam users, and especially to those employing the high-speed engines now coming into general use, is the fact that there is no drag on the engine. The special apparatus here described is positive in its action, and is so constructed that under no circumstances can accident occur to the engine by the "flooding" of the condenser, and the water getting into the steam cylinder, a form of danger from which many of the "injector" and "syphon" condensers, or other forms of independent condensing apparatus, are not entirely safe. It is obviated in the Knowles apparatus by the intervention of a float, seen in the condenser where the shell is broken away (Fig. 2). This float, should any dangerous backing up of the injection water occur, rises, and opens a valve in the top of the chamber, with which it is connected by a rod, and thereby destroys the vacuum, prevents the entrance of water into the steam cylinder and the wrecking of the engine. The apparatus is self-contained, no expensive foundation is necessary, and it requires no additional pump for the injection of water, or a head of water to supply the condenser. It may be placed in any convenient situation in or below the engine room. It will maintain a steady and uniform vacuum (and as high as may be required), no matter how variable the load on the engine may be. It will, therefore, appear that the Knowles independent air pump and condenser is a most effective and reliable apparatus for its intended uses.

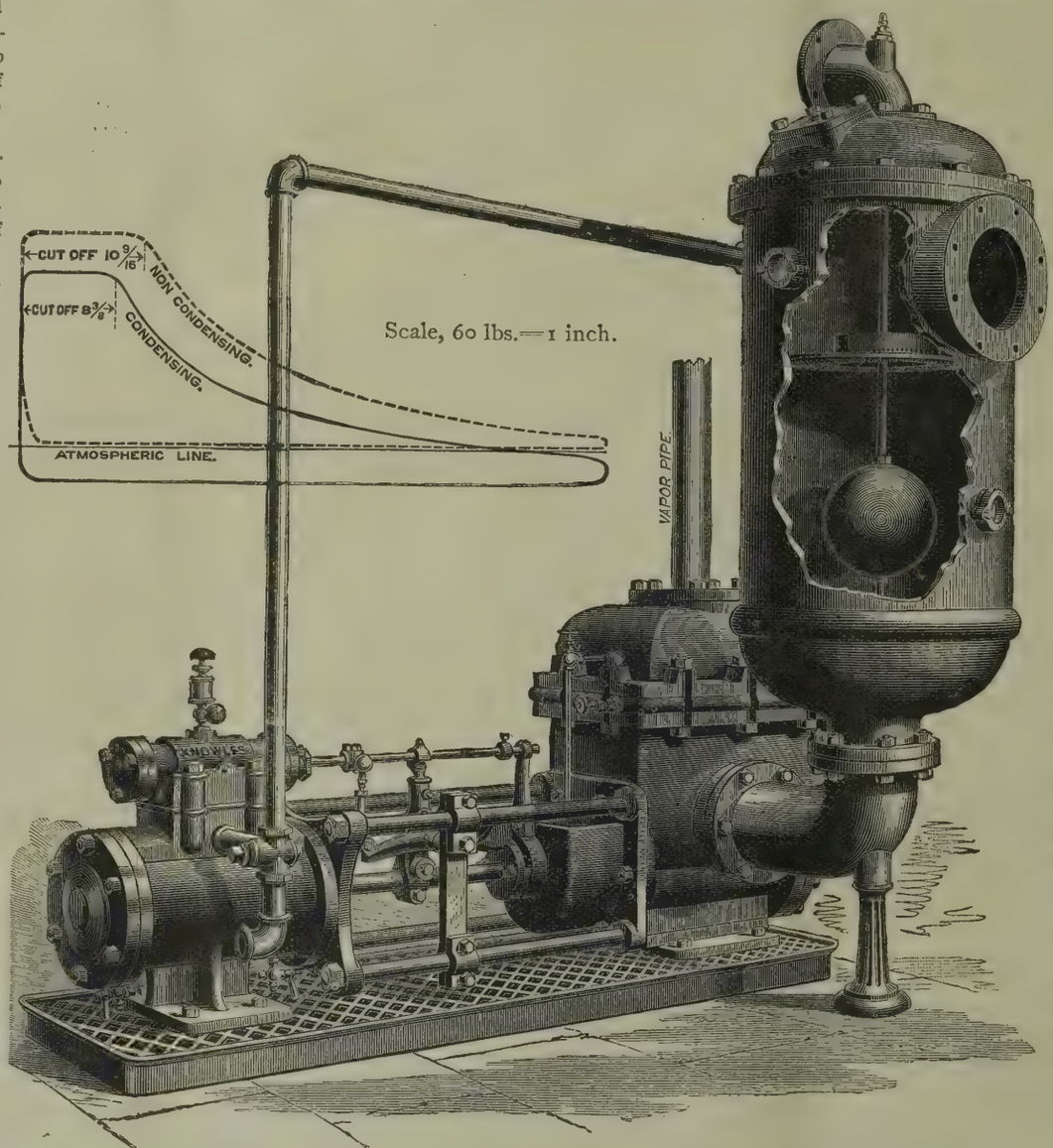


Fig. 2.—KNOWLES' IMPROVED INDEPENDENT AIR PUMP AND CONDENSER.

The diagram given with Fig. 2 represents copies of two indicator cards taken from a 20×48-inch automatic cut-off engine of the Corliss type, with and without the condenser attached. The non-condensing card (shown in dotted lines) shows 70.3 pounds initial pressure, with a back pressure of nearly 1 pound. The condensing card shows 57.5 pounds initial pressure, and a vacuum equal to 12 pounds. The saving of steam here shown is over 30 per cent by the removal of atmospheric and back pressure, and the consequent earlier closing of the cut-off valve. The mean effective pressure in each case is about 30 pounds (speed, 64 revolutions per minute), therefore the power developed is about equal.

Fig. 3 (shown on the opposite page) represents the Knowles improved compound air pump and condenser, which, in respect to its general characteristics, is substantially the same as the independent air pump and condenser above described, differing however chiefly in having a compound steam cylinder, which affords greater advantages in the economical use of the steam. The principles and practical operation of the compound engine are too well understood by our readers to require description at this time. The high-pressure steam cylinder is 6 inches diameter; low-pressure, 12 inches; air cylinder, 16 inches, with a stroke of 16 inches. The high-pressure steam cylinder has the regular Knowles valve motion, which also operates the valve upon the low-pressure cylinder. A compound air pump and condenser of this size is now working, attached to a 300 horse-power steam engine of the Corliss type, with an economy —stated on good authority — of 1.9 per cent of the indicated horse-power of the engine. All the steam required to drive this air pump passes through a steam pipe ½ inch inside diameter.

These machines are manufactured by the Knowles Steam Pump Works, No. 86 Liberty street, New York, and No. 44 Washington street, Boston.

Progress of Electric Lighting.

As intimated in our issue of last month, the arrangements of the Brush company for the lighting of Chestnut street, Philadelphia, with the electric light, were completed, and the system put into practical operation during the past month. The distance lighted is about two miles, or from the Delaware to Schuylkill rivers. The number of lamps is about three to a square. The lamps are supported from iron columns about 20 feet above the sidewalk. The new system has worked smoothly since starting; the lights are tolerably steady, and no complaints of their extinguishment have been made. The amount of light furnished, however, though vastly more than that furnished with the old gas lamps, is something of a disappointment to those who had expected to see the whole length of of the street as bright as daylight. A large amount of light at present is cut off by the use of opaque porcelain globes; it is safe to say that at least 50 per cent is thus lost; and if these were taken off, and ground glass globes substituted—only ground sufficiently to take off the direct glare of the light from the eye—an immense improvement in the intensity of the lights would be made. Thus far, we have no means of getting at the cost of the experiment.

STENCIL INK.—A good and cheap stencil ink in cakes is said to be obtained by mixing lampblack with fine clay, a little gum arabic or dextrin, and enough water to bring the whole to a satisfactory consistency.

Products of the Indiana Paint and Roofing Co.

Our attention has been called to several useful products manufactured by the above-named company, a description of which may be of service to our readers. The first of these is designated by the trade name of "Slate Roofing Paint." It is described as affording a durable, fire and water proof covering for roofs, that can be applied without the aid of heat, and is furnished already mixed ready for use. For tin, iron and shingle roofs, the makers claim that it has no superior. The paint is described as possessing an elastic quality, in virtue of which it adapts itself to the expansion and contraction of the materials on which it is applied, as these are affected by heat or cold. The same quality protects it from peeling, cracking or scaling. Having a mineral substance for its body, it is not affected by atmospheric agencies, nor does it in any way affect the materials on which it is applied, by causing rust or corrosion. Applied to rough wood-work, it is claimed that it will improve and preserve it; and applied on brick walls, that it will effectually prevent dampness from penetrating and discoloring the plastering; applied on old and decayed shingles, it is affirmed by the makers that it will fill up the pores of the wood, giving it an increased durability and making practically a new and substantial roof. The paint dries slowly, and when dry, it is described as affording an elastic, slaty coating, proof against rain and burning embers. For shingle roofs, the paint is of chocolate color when first applied, which changes on drying to a uniform slate color; for tin roofs a red color is found preferable. This material has been manufactured and used during the past fifteen years, and in that time has been largely introduced throughout the country. The makers recommend it especially for factories, foundries, mills, machine shops, warehouses, engine houses, freight cars, depots, farm and seaside buildings, bridges, stables, fences, etc.

The roofing material manufactured by the same company is known by the trade name of "Rubber Roofing." The material is made in sheets or rolls, and presents the appearance of a light, flexible and more or less elastic roof covering. It weighs, according to the statement of the makers, only 60 pounds to the 100 square feet, and is claimed by them to surpass all similar materials in cheapness, fire-proof qualities and durability. It is prepared ready for use, and requires no tar or gravel. It is especially commended to the notice of architects, builders and others for new steep or flat roofs. It is affirmed that it can be laid over old shingles, felt, plastic and mastic roofs with positive satisfaction; and in addition, it is claimed that it will not smell in hot weather; that it sheds water rapidly, and has a handsome finish; that it is as nearly fireproof as it is possible to make any roofing material of its class; and that it is as durable as a tin roof under similar conditions. The body of this material is pure wool fiber, which is saturated with a composition containing rubber, which gives it its pliable and elastic character. When laid, the makers propose that it shall be covered with one or two coats of their fireproof slate paint, above described, with the second coat sanded. With these provisions, the New York Board of Fire Underwriters have fixed the same insurance rate on buildings covered with it, as upon buildings covered with tin roofs.

The makers furnish the material ready for use, with full instructions as to the proper method of using it, and contract for work on old or new structures. The manufacturers are the Indiana Paint and Roofing Co., 28 Kentucky avenue, Indianapolis, Ind.

Iron Statistics of Great Britain.

The annual report of the Mining Record Office of the United Kingdom for the year 1880, gives the following facts and figures respecting the iron industry of that country. The total quantity of iron ores mined in the United Kingdom during the year, was 18,026,050 tons, to which must be added 3,060,690 tons imported, which brings the total of iron ore consumed to the figures of 21,086,740 tons.

The production of pig iron during the year 1880, amounted to 7,749,223 tons, as against 5,995,337 tons in 1879. Of the production of 1880, England contributed 5,752,683 tons; Scotland, 1,049,000 tons; and Wales, 947,550 tons. There were used in the manufacture of the above amount of pig iron, 16,682,629 tons of coal and coke, making the consumption of coal per ton of pig iron, 2 tons, 6 cwt. and 3 pounds.

The number of iron furnaces in blast is stated to have been 567, divided according to location as follows: England, 379; Scotland, 112: and Wales, 76. The average annual output of each of these furnaces, estimated from the figures of total production, was 13,667 tons. From the above brief outline of this important manufacture, it will be inferred that the iron industry in the United Kingdom is in a very flourishing condition.

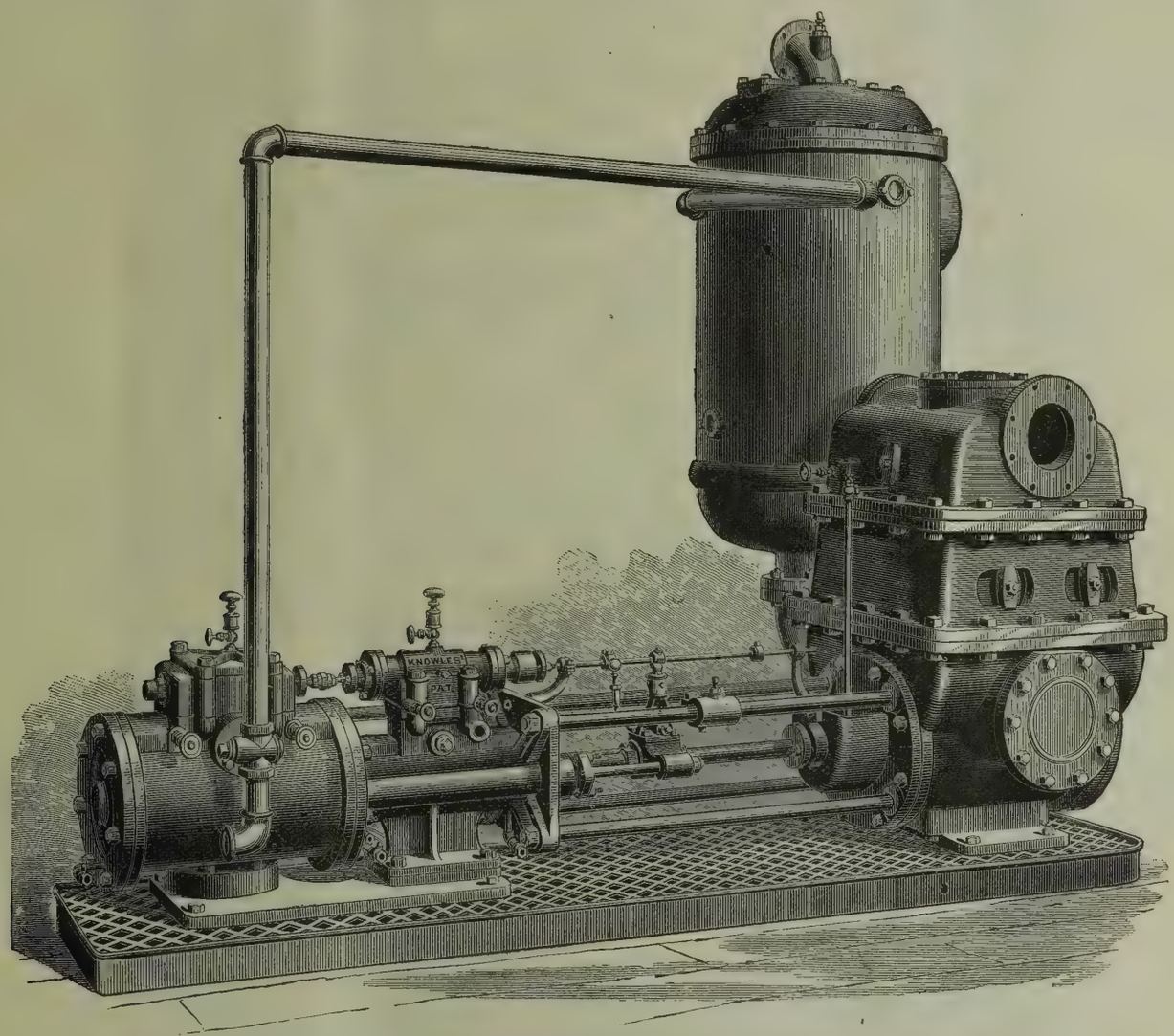


Fig. 3.—KNOWLES' IMPROVED COMPOUND AIR PUMP AND CONDENSER.

THE ST. GOTHARD RAILROAD.—An important undertaking has been suggested by the opening of the St. Gothard Railroad. It is proposed to connect the Adriatic with the Lago Maggiore by a system of canals, of which the terminal will be at Venice and Magadino. This project presents neither financial nor engineering difficulties, and it will probably be actually accomplished.

Rendle's Improved System of Glazing.

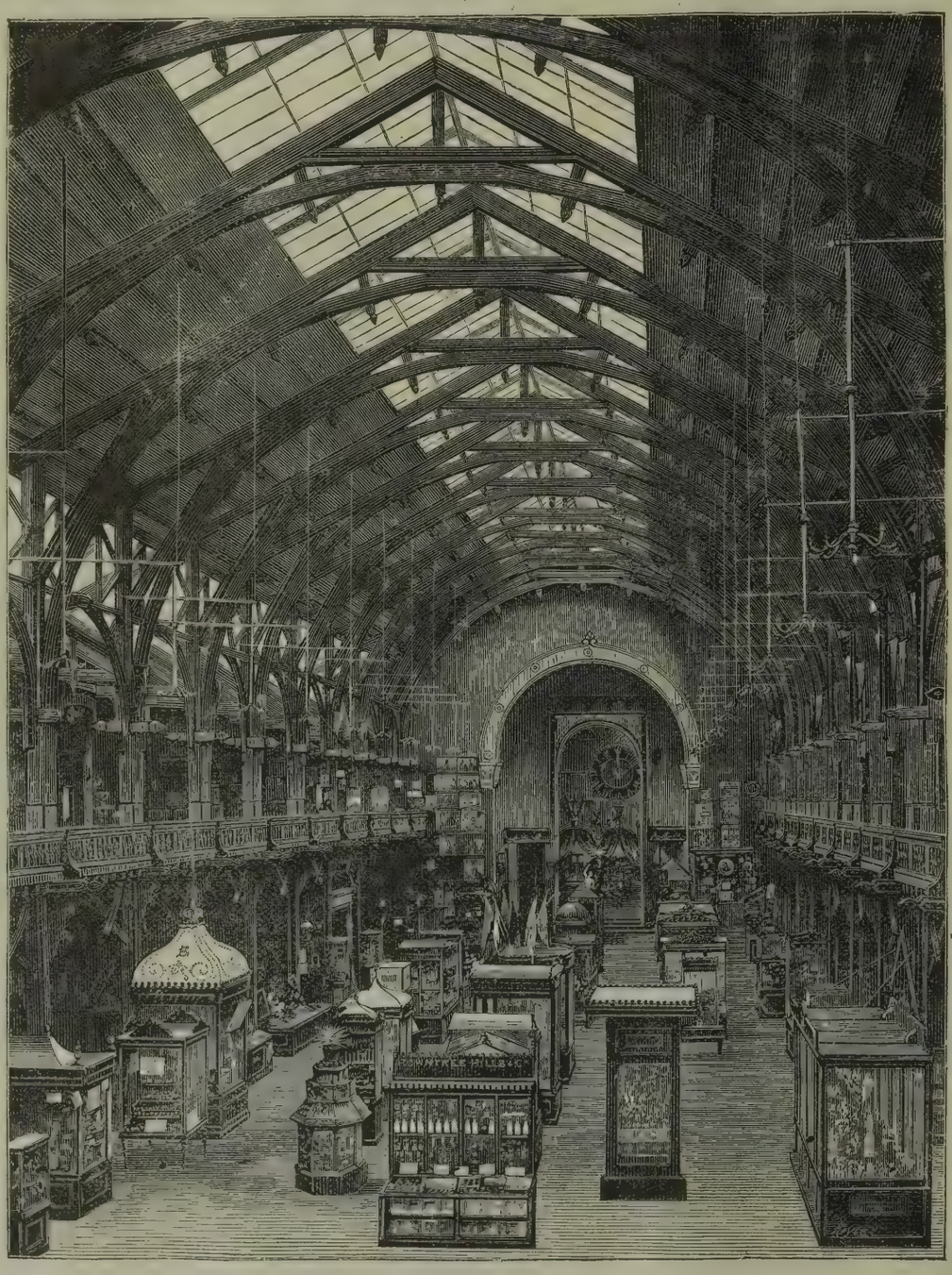
The accompanying illustration is a representation of the interior of the large and elegant building of the Yorkshire Fine Art Exhibition, of York, England, which is glazed on Mr. Rendle's improved "Combination system, and is designed, in connection with our previous illustrations representing the Whitworth gun factory at Openshaw, England, and several elegant designs for conservatories and plant houses, to show the universal adaptability of the Rendle system to every variety of glass roofing called for in practice.

As we have previously had occasion to remark, Mr. Rendle's improved system of glass roofing has achieved a remarkable popularity in England, where it has been extensively adopted in the construction of many of the largest and most notable depots, exhibition buildings, conservatories, plant houses, market houses, machine shops, factories, and the like.

The essential features of Mr. Rendle's system of glazing are as follows: He provides for holding the glass in place with the aid of bent metallic plates, a plan which permits of the glass being readily placed in its proper position, and which holds it securely when in place. It likewise allows the glass plenty of play within the metal grooves, thus providing effectually against the danger from breakage by reason of expansion and contraction by changes of temperature, to which glass held rigidly in place, as is the case with the methods usually employed, is especially liable. In addition to this material advantage, the Rendle system has the great merit of simplicity. It makes a very effectual water-tight joint, as all moisture, whether from within the building or without, is carried off in metallic passages provided for the purpose. Furthermore, this is accomplished without the assistance of putty or cements, which are entirely dispensed with, and the method of construction is affirmed, finally, to afford the greatest amount of strength combined with lightness that it is possible to secure in similar construction.

The Rendle system as exemplified in the building illustrated in our engraving, was honored by the committee of the Yorkshire Fine Art Exhibition with a medal for its general good design and utility. The inventor has just fairly started with the introduction of his system in this country, and has already succeeded in having it adopted in a number of important public buildings—notably in the Buffalo depot of the New York Central & Hudson Railroad Company, which he has furnished with a skylight 460 by 30 feet, the area of glazing being 14,000 square feet.

For special details of Mr. Rendle's several systems of glazing, we refer our readers to our issue for May, 1881, or to the inventor, Arthur E. Rendle, 7 Warren street, New York.



Yorkshire Fine Art Exhibition Building—Glazed on Rendle's Patent "Combination" System.

The Panama Canal.

It is said that the workmen employed on the Lesseps canal are dying off with a rapidity truly startling. American immigrants have fled the country, and the projectors of the canal have finally been compelled to resort to the West Indies negroes, who are impervious to the miasmia, and who are remorseless in their demands for high wages. Work that was estimated to cost 3 cents per foot has cost $1.25, while there appears to be no reasonable hope for a change. It is quite possible that the physical obstacles in the way of the construction of the canal will save the necessity of any painful application of the Monroe doctrine.

Underwriters on Dangers of Electric Lighting.

No better evidence of the growing importance of electric methods of illumination could be desired by its advocates, than is afforded by the promptness with which official bodies which are interested in the subject, take up and discuss matters connected with them. In addition to the report of a committee of the Franklin Institute on the subject of the dangers of electric lighting, we notice one on the same subject made to the New York Board of Fire Underwriters, by Mr. William A. Anderson. As the Fire Underwriters are directly interested in the lessening of the fire hazard from electric lighting, it was to be expected that they would probably formulate a series of reasonable and practicable conditions and precautions by which the use of the electric light should be governed. As a matter of fact, this report is a sensible and practical document. We give briefly in the following the gist of its recommendations, to which the electric lighting companies will of necessity be obliged to conform in future.

To meet the danger of the heating of wires, and consequent danger from fire, where these have not sufficient conducting capacity, the report recommends that "wires have fifty per cent excess of conductivity above the amount calculated as necessary for the number of lights to be supplied by the wire." Another point that is properly insisted upon as essential, is the thorough insulation of the wires. On this point the report insists that the wires shall be double coated, and that they be securely attached to walls, etc., by approved non-conducting fastenings, those of porcelain being recommended and staples of metal condemned as dangerous. A distance of 2½ inches as a minimum between the wires for the incandescent lights, and of 8 inches for the arc lights, is insisted on. Further, it is prescribed that all arc lights be provided with glass globes, enclosed at the bottom in such a manner as to effectually prevent the falling of sparks or fragments of the carbons from the lamps. It is further insisted that the conducting framework of the chandeliers and lamps must be insulated and covered the same as the wires; and that an absolute "cut-off" must be placed at the point of entrance of the current into the house, that the same may be shut off in case of fire.

LARGEST PHOTOGRAPHS IN THE WORLD.—The claim is made for Australia of having produced the largest photographic pictures in the world. These magnificent specimens of the art—not only in point of size, but in respect also of quality—were taken by Herr Holtermann, of Sydney; they are mounted on an endless band of paper, strengthened by linen, and are nearly

100 feet in length. Among the subjects are two colossal panoramas of the cities of Sydney and Melbourne, each of about a dozen sheets joined together in one harmonious tone and depth. One picture, printed from a single negative, was 3 by 5 feet.

The Exeter Engine.

Our illustration represents an admirable plain slide-valve engine, one of the best representatives of its class, which is manufactured by the Exeter Machine Works, of Exeter, N. H. The engine from which the engraving was made, furnished power so satisfactorily at the recent exhibition of the New England Manufacturers' and Mechanics' Institute, held in Boston, that the Executive Committee of the Institute purchased it, to remain permanently in the building.

The general features of this standard type of engine are so well known, that we need only call attention, in the following description, to the distinctive features in general design and construction that characterize this machine. The makers of this engine prefer the use of the rigid cast-iron bed, to take the place of granite, and it may be set on brick-work. The cylinder is connected with the main bearing by the rigid casting so formed as to contain the slides in one piece. The precaution is taken to make all the castings very heavy for the size of the cylinder, which is accurately bored, and of ample thickness to allow of boring many times. All the rods are of steel, and slide through composition bushings. The crank pins are very large, with composition boxes lined with improved Babbitt. The shaft is of forged wrought iron, and the cross-head is made adjustable, so that the least wear can be taken up. The governor is of the Waters pattern, being provided with a stop motion, so that the breakage of the governor belt stops the engine.

The foregoing comprises the most notable distinguishing features of this machine. In other respects, as regards materials employed in its construction and workmanship, it will compare favorably with the best.

The following testimonial from the exhibitors of the model shoe factory, running over one hundred machines, with 500 feet of shafting, and employing from 200 to 300 hands, speaks well of the performance of the Exeter engine at the New England Manufacturers' and Mechanics' Institute Fair, and which, as stated at the outset, was subsequently purchased by the managers:

BOSTON, November 30th, 1881.

WILLIAM BURLINGAME, ESQ., Agent of Exeter Machine Works:

Dear Sir: It gives us pleasure to state that we were well pleased with the power furnished us by your engine at the New England Manufacturers' and Mechanics' Institute fair. During the entire exhibition, it gave us complete satisfaction, being started on the opening day by Gov. Long, and furnished us with even, steady power without the loss of a minute's time, to the closing day, November 12th. It was the only engine that ran full time during the fair.

Your obedient servants,

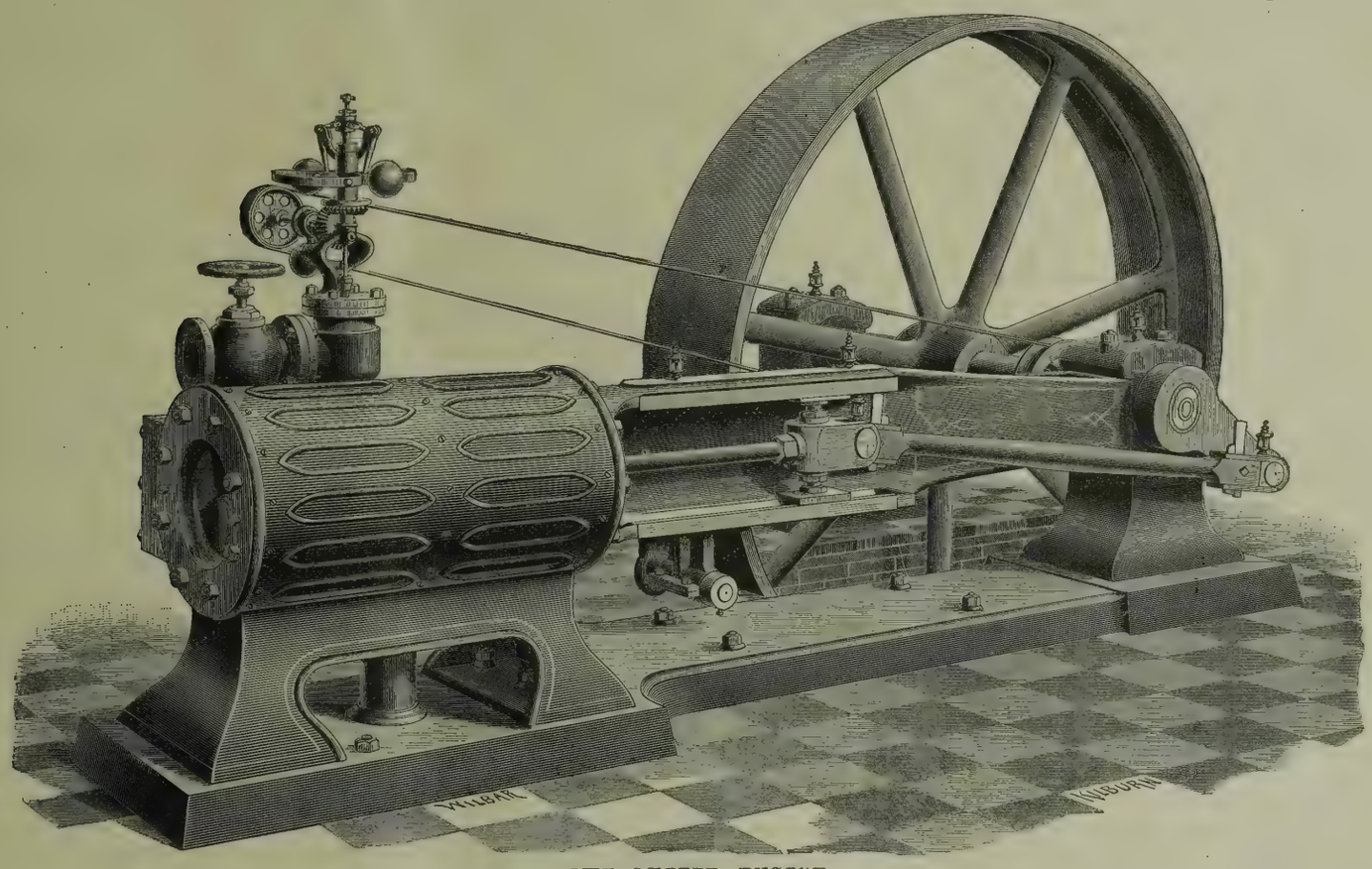
HOUGHTON, COOLEDGE & Co.,
C. H. TILTON, *Superintendent.*

The substantial prosperity of the company is best evidenced by the following news item that has come to our notice:

"The stockholders of the Exeter Machine Works held a special meeting recently, and voted to increase the capital stock of the corporation to $90,000, which is an increase of $30,000. More than one-half of that amount was taken before the meeting adjourned, and the balance has already been subscribed for.

"On November 1st, the Exeter Machine Works purchased of Lorenzo Nealley the stock, tools, machinery buildings belonging to the Exeter Iron Foundry, and the foundry business will hereafter be carried on by them. In addition to the large amount of work done by the Exeter Iron Foundry for the Machine Works, they have had within the past two months over 150,000 pounds of castings done elsewhere. The foundry will be enlarged, and all the castings hereafter used in the Exeter Machine Works will be done here, which will give employment to nearly double the number of workmen now employed in the foundry. Mr. Burlingame has secured the services of Mr. Seth Williams, of Foxboro, Mass., as superintendent of the foundry. Mr. Williams has had between thirty and forty years' experience in this business. He was formerly manager of the Shawmut Iron Works, of Boston, and is now agent of the Foxboro Foundry and Machine Co., where most of the boiler sections used by the Machine Works have been cast for several years. Orders still continue to pour in, and the company are obliged to refuse hundreds of dollars' worth of work every week."

The office and salesrooms of the company are located at No. 50 Federal street, Boston.



THE EXETER ENGINE.

Cost of the Electric Light.

Fears having been expressed that the mural paintings in the Lord President's Court of South Kensington Museum, London, might be injured by the gas used for illuminating purposes, it was determined to try the electric light, and in June, 1880, the Brush system was put in operation. The assistant director of the museum has issued a report upon the working of the light and its cost as compared with gas. He announces that he is having the gas fixtures removed, which may now be done with safety, as the electric lights have worked without any accident for so long. After giving the details of the expenses attendant upon the use of electricity, and the cost of gas from the 22d of June until the 31st of December, the report shows that the saving, as compared with gas, represents 42 per cent. Hereafter the picture galleries and art schools of the museum are to be illuminated with electricity, doing away with the bad state of the atmosphere caused by gas. The London *Engineer*, in commenting upon this report, says: "So far as we know, this report contains the first official statement as to the comparative cost of electric and gas lighting, and the Anglo-American company may be congratulated in having secured such powerful evidence as to the efficiency and economy of their system."

HOLLOW STEEL SHAFTS FOR STEAMSHIPS.—Among the recent improvements introduced in England in building large steamships, are hollow steel shafts, which are chiefly manufactured by Sir Joseph Whitworth & Co. On this system, a 10-inch shaft has a hole 4 inches in diameter, reducing the weight 16 per cent, while the strength is only diminished by 2.56 per cent. With a 5-inch central hole, these figures would be 25 and 4.25 per cent respectively.

Building Intelligence.

Architects, Builders and Contractors are invited to send us items of interest for this department. It is our object to notice only the more important operations in building, our space being too limited for the publication of minor matters, which, besides, possess only local interest. We wish to publish only such intelligence as is of general interest.

NEW YORK CITY BUILDING ITEMS.

Sidney Dillon, President of the Union Pacific Railway Company, is going to erect a private mansion on the thirteen lots on the northeast corner of Fifth avenue and Seventy-sixth street, four on the avenue and eight on the street, that will eclipse any private residence ever erected in this country.

T. F. Treacy will commence early next spring the erection of six four-story brown stone flat houses on the southeast corner of Sixth avenue and One Hundred and Nineteenth street, and five brown stone private dwellings on the corner of Mount Morris avenue and One Hundred and Twenty-first street.

The Smith Brothers are about to erect two extensive apartment houses, one on the north side of Fifty-seventh street, 125 feet east of Ninth avenue, and the other immediately in the rear, fronting on Fifty-eighth street. They are to be seven stories high, built of brown stone, and will contain all the latest improvements, including four elevators. The dimensions of the houses are 75 by 85 feet, with an extension 7 by 17 feet, and they will be arranged so that there will be accommodations for four families on each floor. The plans are from designs by Albert Wagner, and the cost will be nearly a quarter of a million dollars.

Wallack's new theater at the corner of Broadway and Thirtieth street has just been completed. The building has a frontage of 105 feet on Broadway and 122 feet on Thirtieth street. In due course, a nine-story flat-house will rise above the theater, and shops will environ it. The main entrance is on Broadway, and is 30 feet wide, the visitor passing under a portico resting on six polished red granite columns. There are, besides, two gallery entrances on Broadway, an entrance on Thirtieth street, and stage entrances on Thirtieth street and on Broadway. Two *foyers* have been provided, one on the ground floor, 22 by 44 feet in size, and another on the balcony floor, 30 feet by 60 in dimensions, and reached from the vestibule by broad marble staircases. Under these staircases are lavatories and dressing-rooms. The parquet and balcony contain 800 seats, the parquet chairs being of mahogany and garnet silk plush, with folding arms and seats, and backs which rise to a vertical position as soon as the occupant is on his feet. The gallery contains 450 most comfortable chairs. There are also eight boxes. A massive fire-wall—it may not be amiss to mention here that the walls are all massive, the outer ones being quite four feet in thickness—divides the auditorium from the stage. The orchestra is sunken well below the level of the parquet, which slopes easily down to the foot-lights. The proscenium arch is 34 feet high, 32 broad, and 43 deep. A wall at the back of the stage five feet from the rear wall of the building, leaves a broad passageway from wing to wing, and another passageway beneath the stage, 8 feet wide, runs along Thirtieth street to the front of the building. The stage is flat after the fashion of the stage of the Madison Square Theater. Above the stage is a grand paint-room, and below it are the green-room, 15 dressing-rooms for the artists, and an assembly-room for the musicians. The dome over the auditorium is bronzed, with Moorish traceries, eight medallions with heads, and a broad band of blue encircling its base. A wainscoting of mahogany, four feet high, rises from the floor of the parquet and balcony. Above is an amber-colored paper, with a gold figure, concealed almost everywhere by broad panels of embossed garnet velvet, alternating with delicately painted panels 18 inches broad, and covered with glass. The balusters of the balcony are dark gold above and bright gold below, with a blue frieze underneath, and garnet plush upholstery. The walls of the boxes are drab and gold embossed velvet, in a framework of blue embossed velvet, and the curtains are of garnet plush. Within there are small cabinets against the walls, tête-à-tête chairs, and divers artistic knicknacks. A magnificent chandelier of copper and brass, with a spread of 14 feet and 200 burners, depends from the dome, and smaller gas fixtures spring from the painted panels on the walls and other points. Electric lights are used outside the theater, and the question of employing them within was mooted for awhile, but finally dismissed from immediate consideration. It only remains to add that two large reservoirs in the roof of the theater communicate by means of pipes with all parts of the house and will promptly check an ordinary outbreak of fire. The architect of the establishment is George A. Freeman, Jr.

During the past year there has been such an activity in the building trade in this city, as was never before known here or elsewhere. At the present time there is no abatement to this activity, and so long as the weather permits there will be plenty of building. As far as can be ascertained architects, builders, and mechanics, are likely to be as busy during the present year as they were last year. The largest amount expended in 1881 was in the construction of first class dwellings, the total being over $18,000,000. The owners of these buildings, unlike those of property in the lower part of the city, where the buildings are every day being made higher and higher, have large areas to cover so as to make the dwellings as imposing as possible. After the first-class dwellings come the English and French flats, the amount invested being over $9,000,000, and then tenements with stores, $4,000,000 and upwards. The estimated cost of the different buildings for which plans were sent in to the Department of Public Buildings during the first six months of the year amounted to as much as the whole business of the previous year, and that was considered an exceedingly good year. The cost for the first six months was over $29,000,000. For the last six months, although the decrease in the number of plans filed has not been very great, there has been a decided change in the estimated cost; but that was to be expected. The building season commences early in the spring, and those who contemplate doing so have everything fixed so as to avoid delay. The amount expended for new schools, was $179,000 for six schools, while for churches there was expended $127,000. The following statement will show in what way the money was spent in erecting the different classes of buildings during the year, the figures being taken from the records of the Department of Buildings:

Classes of Buildings.	*Number.*	*Estimated cost.*
First-class dwellings	791	$18,482,550
Second-class dwellings	159	607,850
French and English flats	266	9,246,500
Hotels	8	836,000
Tenements and stores	166	4,864,200
First-class stores	41	294,200
Second-class stores	39	231,500
Third-class stores	26	48,250
Offices	24	4,309,200
Factories	53	1,391,100
Schools	6	179,000
Churches	6	127,000
Public buildings	30	2,179,500
Stables	105	744,125
Workshops	43	92,235
Frame buildings	113	475,460
Tenements	548	3,676,000
Total	2,424	$47,784,670

MISCELLANEOUS.

At Circleville, O., Roth Bros. intend erecting a brick hotel on the site of the American House.

The Howard Locomotive Works are to erect a factory at Pullman, Ill., at a cost of $1,250,000.

At Meriden, Conn., a new stock company hotel is to be built by Walter Hubbard. It will cost about $125,000.

An orphan asylum, to replace one lately burned, is to be built at Womelsdorf, Pa., at a cost of $25,600. T. F. Durang, of Philadelphia, is the architect.

A passenger and freight station is to be built at Kinzua, Pa. The contractors are the American Construction Co., and the architects Wilson Bros. & Co.

At Clifton, O., Truman B. Handy is about to erect a limestone dwelling-house, from designs by James W. McLaughlin, architect, of Cincinnati. The cost will be $50,000.

It is the intention of W. H. and G. W. Allen to build a five-story factory on Race street, west of Fourth, Philadelphia, to be of brick and iron, and will be used for light manufacturing purposes.

Fairchild & Todd, builders, of Orange, N. J., have just closed a contract for the erection of a handsome private residence for E. G. Burgess, on the Montclair side of the Orange Mountains, to cost $40,000.

An edifice, to be called the Watkins Institute, is to erected at Nashville, Tenn. The plans of Bruce & Morgan, architects, of Atlanta, Ga., have been accepted. The cost of the structure will be $100,000.

The corner-stone of the new Swedenborgian church, on the northeast corner of Twenty-second and Chestnut streets, Philadelphia, was laid recently. The building will be 64 by 92 feet, and built of brown stone. The total cost, exclusive of furniture, will be about $32,000.

The friends of the late President of the Pennsylvania Railroad Co., have determined to erect a memorial church in Philadelphia, to be called the Thomas A. Scott Memorial Church. It is proposed to raise $50,000 to build it. The church is to be mainly for the use and benefit of the employees of the Pennsylvania Railroad Co.

At Trinidad, Colo., an opera house is to be built. It will have a frontage on Main street of 104 feet, and will be 100 feet in depth. There will be four store rooms on the first floor, and theater and six offices on the second floor. The front is to be of Trinidad sandstone. The entire cost of the building will be $25,000. Norval W. Wall is the architect.

T. A. and W. T. Wilson, of Baltimore, have completed a set of drawings for a frame and stone hotel to be located at Rogers' Station, Baltimore county, Md., and be known as the Strontia Mineral Spring Hotel. The building will be 144 by 250 feet, have accommodations for 200 guests, and is to be completed by next summer. The cost will be about $50,000.

The plans drawn by William Field & Son have been adopted for the erection of the new hotel at Babylon, L.I., by the Long Island Improvement Company. It will be in the modified Queen Anne style, with a frontage facing the ocean of 270 feet 2 inches. The eastern end, overlooking the fresh water lake, will be 149 feet, 6 inches in depth. The western front will contain the dining hall, 47 by 97 feet, and will be one story high the distance from the floor to the top of the peaked roof being 45 feet, the latter commencing on a level with the second story of the main building. All the windows in this part of the building will be handsomely decorated with stained glass. The main building will be three stories high, while the central portion, which will be 60 feet square, will be five stories high. There are to be three corner pavilions, each 38 feet square, projecting out diagonally from the building four stories high, and terminating in four gables on each. The hotel will be surrounded by a piazza, 15 feet wide except on the ocean front, where it will be 30 feet in width. It will contain three main staircases and a number of private ones for the use of the help. In all there will be two hundred guest rooms. There will be an eliptical air shaft in the center of the main building, extending to the clear above the roof. The kitchen is to be in an independent building, 36 by 50 feet, and connected with the dining-room by a wide passageway. The plan is so constructed that all the sleeping rooms will have either a lake or ocean view. The cost of the building alone will be $80,000, and the contract for its erection has been awarded to John Lee of Brooklyn. It is the intention of the owners to make this a strictly family hotel, and they expect to have it ready for occupancy by June 1st, 1882.

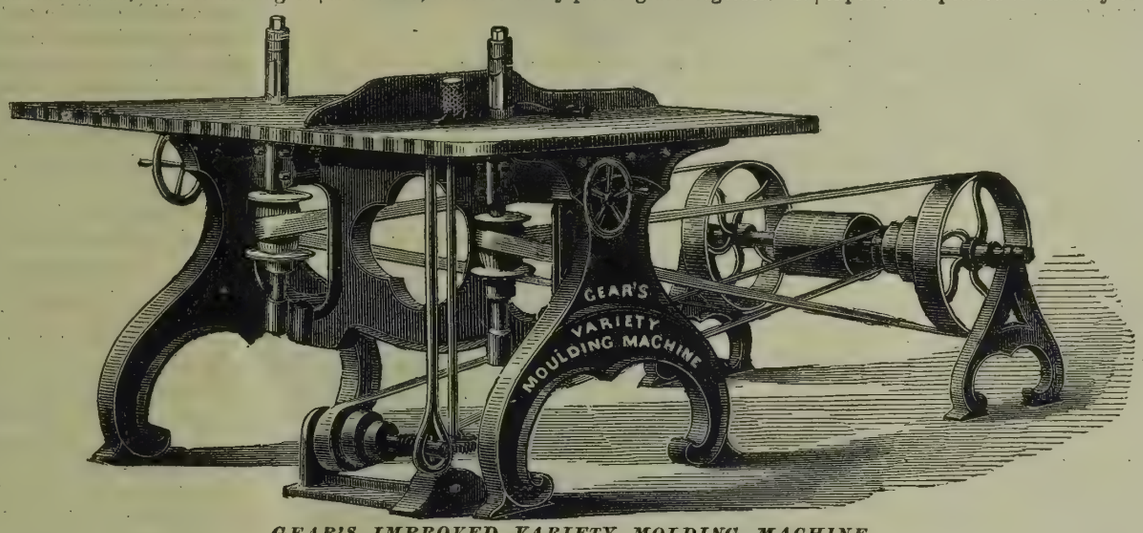
Paper Car Wheels and Axle Service.

It having been demonstrated by a record of car axle service kept by the Pullman Car Company since 1874, that no broken axles have been found upon which paper wheels are used, the *National Car-Builder* gives the following explanation of the fact: It is claimed that the difference in the construction of the two kinds of wheels (iron and paper) is such as to cause a material difference in the strain upon the axles, the strain being comparatively less in the case of paper wheels. It is admitted that in both cases the wheels are pressed on with the same average pressure, so that in this respect there is nothing to favor the axle in the one class of wheels more than the other. But with the paper wheel, the solidified paper—which is apparently as hard, heavy and unelastic as metal—is interposed as a medium between the tire and the hub, and as such, absorbs or lessens to an appreciable extent the jars from the rail joints and other inequalities of the track; or, in other words, the paper acts as a non-conductor in preventing the transmission of the full force of the blows through the wheel structure to the axle. With the iron wheels, however, it is claimed that the metal being continuous from tire to hub, there is nothing to relieve the axles from the full impact of the blow of the wheel upon the rail, and the result is to produce crystallization at an earlier stage of service, and consequently liability to breakage. This is the theory, and it seems to be a plausible one, supposing the wheels in both cases to be of the same diameter. But in the case of 42-inch paper wheels and 33-inch iron wheels, it is obvious that the larger wheels will pass over obstructions more easily and with less strain upon the axles than wheels of a smaller diameter.

The construction of these wheels is thus described in the *U. S. Trade Journal*: "The paper is straw-board of rather fine texture. It is received in the ordinary broad sheets, differing in no particular from those used for straw-board boxes or other similar work. These sheets, as they come from the paper mill, are square, and must first of all be cut to a circular pattern. This is rapidly done on a large table with a knife that is guided by a radial arm that swings freely over the surface of the table from a pivot at the center. A small disk is also cut from the center of the sheet, to allow for the iron hub. Being thus reduced to the required shape and dimensions, the paper must now be converted from a mass of loose sheets into a compact, dense body, capable of withstanding the tremendous crushing force to which it will be subjected in the wheels. This is accomplished in the following manner: Ten sheets are pasted together, one upon the other, making a disk about one-eighth of an inch thick. Enough of these disks having been prepared to fill a powerful hydraulic press, they are subjected to a pressure of 1,880 pounds to a square inch. When removed, the disks are hung on poles in a steam-heated loft and left six days to dry. Thicker disks are then made, each formed by pasting together two or three of those already finished. These are pressed and dried as before, and the process is repeated until a block is built 4 inches thick and of about the specific gravity of lignum vitæ. After each pasting and pressing, six days are allowed for drying, and when the block is complete it is left in a drying-room until thoroughly seasoned. The next operation is that of turning the paper blocks to fit the steel tires and iron hubs. This is done with as much accuracy, and in exactly the same manner, as if the material worked on were iron or wood. The circumference is turned to a perfect circle of the precise diameter required, a bed or recess is worked out for the web of the tire to rest in, and the edges sharply defined. The block is then painted, and is ready for its place in the wheel."

Gear's Improved Variety Molding Machine.

Our illustration represents an improved wood-working machine designed for the purpose of planing and molding irregular and straight forms in wood, and favorably known to wood-workers as Gear's Variety Molding Machine. Several sizes and modifications of these machines are built, which are designated in the catalogue of the makers by letters. The cut herewith shown illustrates the C machine, provided with 1⅛, 2¼ and 3½ inch heads, with feed tables and connections for all descriptions of irregular and straight work, and with countershaft. The machine is built entirely of iron and steel, with the exception of the table, which is of wood, made of thirty pieces glued together. It occupies a space of 4 feet 9 inches by 4 feet 2 inches, and weighs about 1,000 pounds. The hoisting apparatus and steps, together with the feed-table attachment, with which they are provided, are peculiar to these machines, being of the special manufacture of the makers, and are claimed to materially enhance the practical value of their machines.



GEAR'S IMPROVED VARIETY MOLDING MACHINE.

The C machine here described is largely employed in furniture, sash, door and blind factories; chair, boat, car, carriage, agricultural implements and plough manufactories, etc., and will be found admirably adapted for the needs of any establishment where a machine is required to plane crooks and sweeps up to 6 inches. The tight and loose pulleys are 10 inches in diameter and 5 inches face, and are directed to be run at about 900 revolutions per minute.

The machines designated by letters A and B are similar in design and construction, differing only in capacity or in the absence of certain of the above-named attachments.

Information respecting these machines, and other special details, may be had by addressing the makers, S. K. Lovewell & Co., manufacturers of wood-working machinery, 31 and 33 Broadway, Chelsea, Mass.

Figures Regarding the World's Shipping.—From statistics recently compiled in regard to the shipping of the world, it appears that, omitting vessels of less than fifty tons measurement, Europe possesses 42 tons to every 1,000 inhabitants; America, 40; Australia, 79; and Asia and Africa only 2 tons per thousand. Liverpool with a tonnage 2,647,373, ranks as the most important port in the world; followed by London, with 2,330,688; Glasgow, 1,432,364; New York, 1,153,676 tons. The nine leading ports of Great Britain have a tonnage of 8,724,123, while the first four ports of this country have only 1,976,940 tons. Twenty years ago this country carried 66 per cent of its foreign trade in American built and American registered vessels, but it has gradually declined until now it is less than eighteen per cent. The gross tonnage of Great Britain and Ireland amounts to about 12,000,000 tons, and including that of the colonies the British flag protects 14,000,000 of the world's tonnage of 27,000,000.

Strength of Bronzes.

In a paper lately read before the American Society of Civil Engineers, Prof. R. H. Thurston described a new bronze alloy of maximum strength. The properties of this alloy were ascertained by Prof. Thurston in the course of his examination in the mechanical laboratory of the Stevens Institute of Technology of a series of 36 alloys of copper, tin and zinc, in which the proportions of the copper were varied from 10 to 80 per cent; of the tin, from 10 to 80 per cent; and of the zinc, from 10 to 70 per cent. The results of these experiments pointed to an alloy of the proportions of copper 55, zinc 43, and tin 2, as likely to be that possessing maximum strength; and on Professor Thurston making the alloy, he found it to possess a good color, to be close grained, and susceptible of high polish. It was also found to have an immense strength, considerable hardness, and moderate ductility, while it could also be forged if carefully heated. For purposes demanding toughness as well as strength, Prof. Thurston found, however, an alloy with less tin preferable, and he gives the proportions of copper 55, tin 0.5, and zinc 44.5 as affording the best results. This alloy, he states, has a tensile strength of 68,900 pounds per square inch of original area, and 92,136 pounds per square inch fractured area, while it elongated from 47 to 51 per cent (length of test sample not stated), and reduced to 0.69 to 0.71 of its original diameter before fracture.

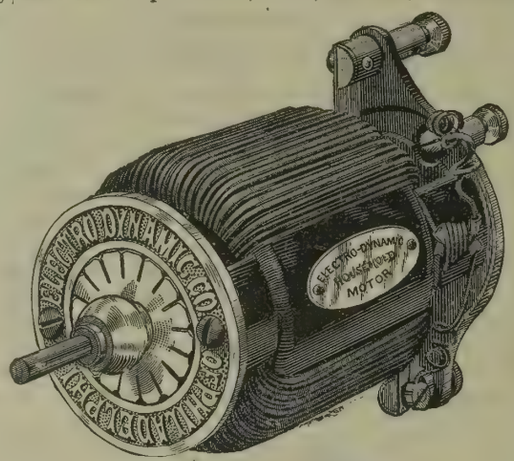
He also states that the shavings produced by the action of the turning tool on this alloy curled closely, and were tough and strong, like those of good iron. Prof. Thurston also referred to an alloy discovered several years ago by Mr. J. A. Tobin, but which appears not to be generally known. This alloy, which consists of copper 58.22, tin 2.3, and zinc 39.48, had, when cast, a tensile strength of 66,500 pounds per square inch of original section, while when rolled hot its tenacity rose to 79,000 pounds per square inch, and when moderately and carefully rolled cold, to 104,000 pounds per square inch. It could also be bent either hot or cold, and was found to make excellent bolts and nuts, while it could be forged at a low red heat.

Technical Schools in Russia and France.—Russia and France are just now most active in establishing manual training schools. In the Russian technical schools pupils pay about $15 a year, taking ordinary school instruction for four and a half hours a day and working for five hours. Austria has eighty industrial schools, which give instruction to about 4,000 pupils. In the French schools articles are manufactured for sale.

Griscom's Electric Motor.

A committee of the Franklin Institute appointed to examine and report upon the merits of this ingenious apparatus, have lately published the results of their labors. They are very favorably impressed with the utility of the motor, and recommend "Griscom's electric motor and battery to the favorable consideration of the Franklin Institute as an apparatus possessing great power in proportion to its size, simplicity in its construction, excellence in its mechanical details, and general adaptability for household use." This recommendation of the committee was approved by the Board of Managers of the Institute at their meeting held November 9, 1881.

We give in the following an illustration of the apparatus and the battery, and a brief summary of the committee's report upon this invention, which appears to represent a useful and valuable application of electricity as a motive power for many domestic uses. The mechanism of the Griscom motor may be described as follows: The motor consists, briefly, of two semi-circular electro-magnets, which together form a ring; their poles project inward, and, together with the wire coils, form a cylindrical tube within which a Siemens armature revolves. The poles extend laterally beyond the ring, forming supports for the brackets which carry the bearings of the armature and the brushes of the commutator. In order to reduce the wear of the journals to a minimum, the bearings are made four times the diameter of the shaft, and the direction of the wear is a ways from the point of nearest approach, so that the poles of the armature and magnets can never come in contact from this cause—a frequent source of annoyance and danger in former motors. The friction wheels of the brushes are in pairs, and the shape of the commutator is such that one wheel will always touch one-half of the commutator before its companion leaves the other. The tension of the belt is readily adjusted by means of a fork which carries the motors.



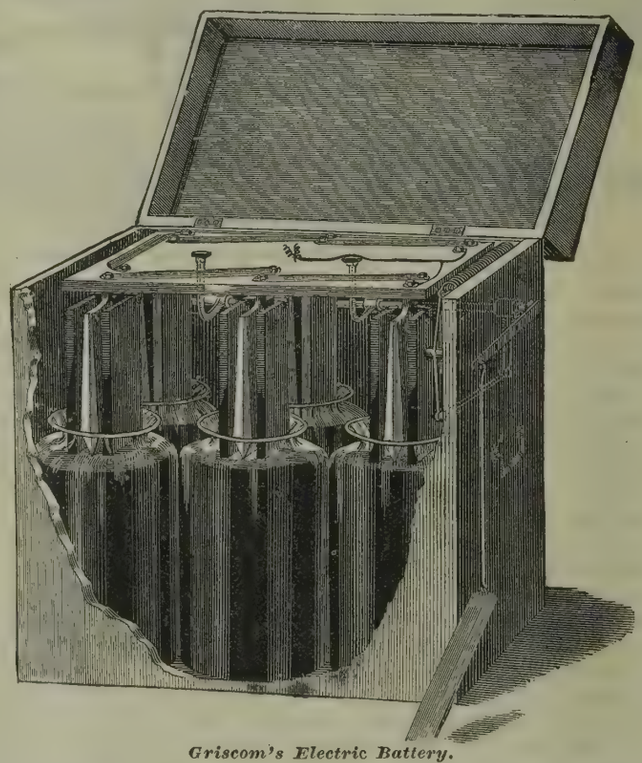
Griscom's Electric Motor.

The battery consists of six one-gallon cells, into each of which plunges a plate of zinc 4 inches long and 2 inches wide, and two plates of carbon exposing a like surface. The large amount of liquid (electropoion) is merely to save the trouble of frequently recharging; a battery containing six drachms per cell gives equal power, but for a shorter period. It is estimated that the battery once charged, will continue to supply the motor with sufficient power for all ordinary use of a sewing machine in a private family for many months, or probably one year, without refilling.

Respecting the power of the motor, the committee report that as this depends upon the quantity of electricity furnished by the battery, it is easily regulated by raising and lowering the plates in the exciting fluid. They found that when the plates were but partially immersed in the fluid, sufficient power was generated to answer for all the ordinary requirements of a sewing machine, and that when fully immersed the power generated was sufficient to drive a large needle through sixteen layers of cotton cloth at a very rapid rate. The operation of immersing the plates in the battery fluid is accomplished in several ways. Where the motor is attached to a sewing machine, this is done by a movement of the treadle, and the speed of the machine is kept under complete control by the pressure of the foot, by which the plates are immersed to a greater or less depth. When the foot is removed, the plates are automatically withdrawn from the fluid. The motor proper is 2¼ inches in diameter and 4 inches long, and weighs but 2¼ pounds. It is securely attached beneath the table of the sewing machine by a light frame.

The exciting fluid of the battery consists of a mixture of sulphuric acid and bichromate of potassa, which has the merit of giving a powerful current and of evolving no noxious fumes. The method of graduating the strength of the current, and consequent speed of the motor, is as simple as it is effective. A very slight pressure of the foot on the treadle suffices to start the machine as gradually as may be desired; the speed may then be increased up to one thousand or more stitches per minute, which, it is said, is considerably faster than is now attained by professional sewing women, while others seldom sew more than 300 to 400 stitches per minute.

Two forms of the battery were shown, in both of which the plates are automatically raised above the bath when not in actual use. In one form this is accomplished by means of a spiral spring attached at either end of the bar to which the plates are permanently fastened. In the other a similar result is attained by means of a counter-weight on the small arm of the lever attached to the treadle.



Griscom's Electric Battery.

The committee conclude their report with the statement that the important novel feature in this battery consists in the size of the cells, which thus enables it to continue operative, without recharging, for a great length of time. As the current is necessarily intermittent when the motor is running, and as the plates are frequently raised and lowered by the operator to accommodate the needs of the work of sewing, the main objection to the ordinary Grenet battery—namely, the rapid deterioration when the constant current is required—is avoided to a great extent, while its advantages for household and occasional uses are retained. These are as follows: It generates no gases or vapors that are practically deleterious; the zinc elements do not, as in other batteries, require frequent amalgamation or attention, and when not in use are simply raised above the fluid and allowed to drain.

In reviewing the report of the committee, we fully coincide with their opinion as to the many practical and useful features which the Griscom motor possesses. The only point where it appears to us the committee has not properly investigated, is the important one of the permanence of the battery. This the committee pass over with the remark that "it is estimated that the battery, once charged, will continue to supply the motor with sufficient power for all ordinary use of a sewing machine in a private family for many months, or probably one year, without refilling." If this fact can be verified, the great practical value of the motor will be obvious; but it does not appear that the committee took the occasion to verify this estimate, or if they did, it nowhere appears in their report.

It appears to us that what the Griscom motor requires is something like the secondary battery of M. Faure, which could be sent around to private houses at regular intervals, charged from a dynamo-machine with as many foot-pounds of electrical energy as would suffice for the uses of the family for two or three months, and replaced by freshly charged ones. As we were informed by representatives of the company a short time ago, that they have been engaged in perfecting their battery before putting their machines upon the market, it is possible that the idea here advanced may have occurred to them.

European Forests.

The *Journal* of the Société des Agriculteurs de France publishes some interesting particulars with regard to the forests of Europe and the rapid consumption of the timber which they contained. Sweden and Norway, which still do a large export trade in pine, are now compelled to buy their oak in Poland; and in Russia the forests along the shores of the Baltic, in Finland, and in the Southern provinces, are so rapidly thinning that the forest acreage of the empire is now only one in ten. There are about 34,000,000 acres of forest in Germany (of which 20,000,000 are in Prussia), bringing in an income of $50,000,000 per annum. The State forests are taken great care of in all parts of Germany, in Prussia alone $500,000 being spent every year in replanting. The imports of timber exceed the exports by over two million tons. Austria and Hungary have upward of 43,000,000 acres of forest; but in Austria proper the State does not possess more than 7 per cent of the wooded area, and Austria is now obliged to buy most of her timber in Bosnia and Montenegro. Servia and Roumania have some very fine forests; but Italy, though her forest area extends over nearly 14,000,000 acres, does not do much in the way of a timber trade, as the roads leading to the forests are so bad that it is almost impossible to move the timber when cut. Much the same is the case with Spain, which has 8,500,000 acres of forest; while Portugal, which has only a million acres, finds a good market for her timber.

THE SILK INDUSTRY is reviving in Louisiana, the reports of last spring's hatching being very encouraging. Interest in the culture is growing, and inducements are offered to silk workers to come from France and engage in the business. The first exports of silk from Louisiana were made as far back as 1718. The culture of silk is also being revived in South Carolina and Georgia.

Improvements in Wood-Working Machinery.

The following illustrations, with descriptive explanations, relate to recently patented inventions in the department of wood-working machinery. It is our intention in the future to make such descriptions from the list of patented inventions, from time to time, a standard feature of the MANUFACTURER AND BUILDER. We shall select for this purpose only such inventions as appear to us worthy of special notice, and shall make our descriptions as full as the facts at hand and the subject will admit.

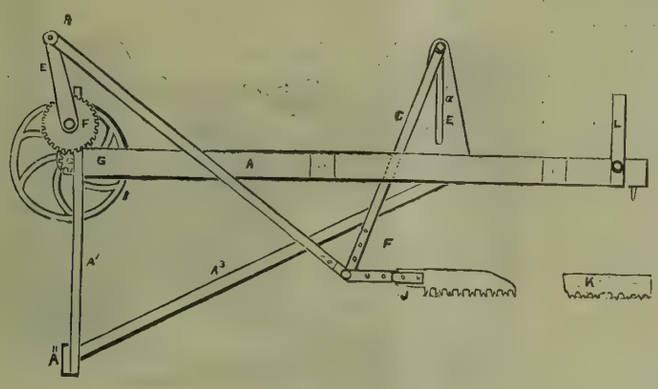


Fig. 1.

Fig. 1 represents an improvement in drag saws invented by George B. Durkee, of Chicago. The improvement consists substantially in the manner of supporting the saw, and rendering it adjustable to suit the work to be done, and of communicating motion to it from the driving mechanism. The machine consists of a frame or support, as seen in the cut. Attached to a portion of this—that is, to the horizontal main bar A, is an upright B, having a vertical slot *a*. A depending swinging arm C is connected with the upright B by means of a bolt and set-nut, the slot enabling it to be adjusted and attached at any suitable hight. The lower end of the swinging bar is connected with the saw clamp J, and with the pitman, through which reciprocating motion is communicated to the saw blade.

Fig. 2 represents an improvement in lumber trimming machines, invented by W. B. Swartwout, Three Rivers, Mich. The inventor provides in this machine a means of automatically depressing intermediate saws beneath the bed or table of the machine. The means employed to effect this, consist substantially of a cord *p* rigidly attached to a swinging saw frame at or near its weighted end, and passing through suitable guideways, in combination with a pivoted lever P, adjacent to the next succeeding saw frame.

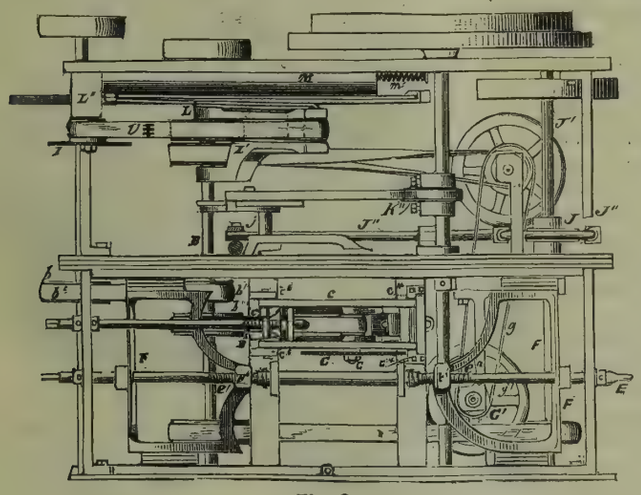


Fig. 3.

Fig. 3 represents a combination wood-working machine, embracing improvements patented by Reuben H. Andrews, Washington, D. C. It consists substantially of a vertically adjustable table, resting upon sliding yokes, and provided with devices for operating a shaping tool, a jig saw, and a circular rip saw. The improvement consists in the combination of three devices, and their arrangement for operation in connection with the adjustable table before mentioned.

Fig. 4 represents an improved method of supporting, operating and feeding reciprocating saws, patented by David Berry, Bolinas, Cal. The frame or support A carries the sliding saw frame F, to which the saw G is attached. A reciprocating motion is communicated to the saw frame and saw by means of the pitman L, which is connected with the driving mechanism in the manner shown in cut. A stop piece K is an essential feature of this invention. The pitman strikes against it, and jars the saw frame F. The object of this artifice is to cause the saw frame to be fed downward.

Artificial Cultivation of Sponges.

Some time ago we invited attention to the fact that several Austrian scientists had demonstrated the feasibility of artificially propagating the sponge by actual experiments in the Mediterranean, with the fine sponges that grow there. The method they adopted was simply to cut the living sponges into small pieces, which were then attached, at suitable distances apart, to a framework of wood, which, when filled, was weighted and sunk beneath the surface of the sea. These sponge fragments were found not only to retain their vitality, but to increase rapidly in size, so that a few years sufficed to produce marketable sponges therefrom at comparatively trifling cost.

In view of the rapid exhaustion of the sponge fisheries in the Mediterranean, the foregoing demonstration was looked upon as of great practical value, and the Austrian government gave official encouragement to the conduct of a series of similar experiments. These were, unfortunately, nullified by the jealousy and ignorance of the sponge fishers, who foolishly imagined that their industry would thereby be injuriously affected, and they repeatedly destroyed the wooden platforms and their contents. The experiments met with such strenuous opposition from this source, that they were finally abandoned, and have never been renewed.

We learn, however, from the *Oil and Drug News*, that experiments in the artificial cultivation of sponges have lately been undertaken, and with very promising results, at Pine Key, Fla. The pieces of sponge referred to in this case are spoken of as being simply transplanted, and not cut into small fragments as in the Mediterranean experiments. These were found to increase in size from two to seven or eight inches in diameter within the period of seven months.

The suggestion is now made to transplant the finer Mediterranean sponges and attempt their artificial propagation, and there is little doubt but that it would prove more profitable to raise them in our own waters than to import them. The superior quality of the Mediterranean sponge, however, is largely due to the extreme clearness of the water in which it grows, and much care would have to be exercised in the selection of the situation in which to cultivate them. As the possible indication of an entirely new industry, the foregoing is worthy of notice.

Hardening Steel.

The effect of occluded gases in iron and steel, says *Engineering*, is now being carefully studied by metallurgists in general, and a committee of the Institution of Mechanical Engineers recently raised the question in one of its reports as to whether the hardening and tempering of iron and steel might not be produced by the expulsion of occluded gases during the heating process, and their subsequent exclusion by the sudden cooling and contraction. Prof. Chandler Roberts has undertaken to answer this question, and by heating rods and steel in vacuo by means of the electric current, and suddenly quenching them in cool mercury, he demonstrates that steel will harden when there are no gases to absorb. The metal was, of course, robbed of its occluded gases by means of an air pump connected with the vacuum chamber, and the parts which were quenched in the mercury were found to be glass-hard, while those which did not reach the cold fluid were found to be quite soft. Prof. Roberts, therefore, concluded that gases do not play any part in the process of hardening and tempering. Prof. Hughes, who has made numerous experiments on the subject, believes that the temper of steel is due to the chemical union of the iron with the carbon. At low temperature this union takes place only in a slight degree, and hence in soft steel we have the carbon keeping aloof from the iron; but as the temperature is raised the combination is furthered, until, in the case of gray or hard steel, we have really a kind of diamond alloyed with iron. Sudden cooling is necessary to fix the combination, for in slow cooling the carbon separates from the iron. This theory is a very promising one, and is supported by a variety of facts, Mr. Stroh, for example, having observed that when an electric spark passes between two iron contact pieces and fuses them, the fused part becomes diamond hard, and will scratch a file.

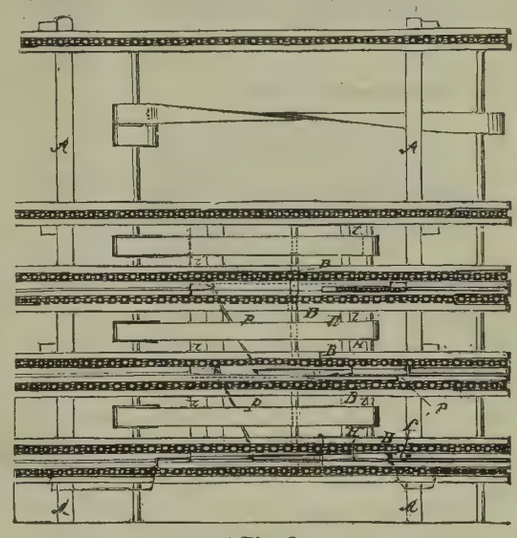


Fig. 2.

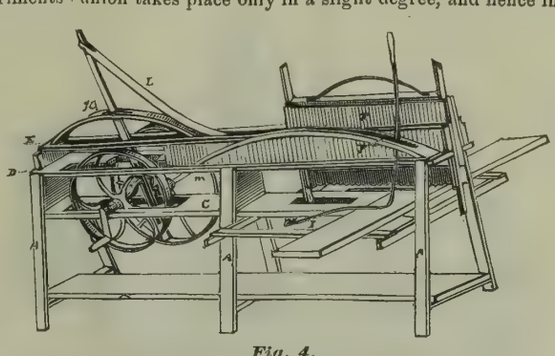


Fig. 4.

AN EXHIBITION OF SMOKE-CONSUMING APPARATUS is now in progress at the South Kensington Museum, in London, and many interesting and useful devices of this kind are reported to have been brought forward.

The Dayton Wheel Works Explosion.

The newspapers of the day have lately given much space to accounts of a disastrous boiler explosion, attended with serious destruction of property and lamentable loss of life, which occurred at the Dayton Wheel Works, a well-known and prominent manufactory of light vehical wheels, on the 25th of October just passed. The cause of this calamitous accident was the subject of much earnest debate at the time it occurred, and professional boiler experts presented contradictory opinions, or expressed their ignorance concerning it. We have deemed it of use to our readers, in view of the general interest manifested in this case, to give a somewhat detailed account of it, together with such inferences as to the cause of the explosion as seem to be warranted by the facts, which we do in the following:

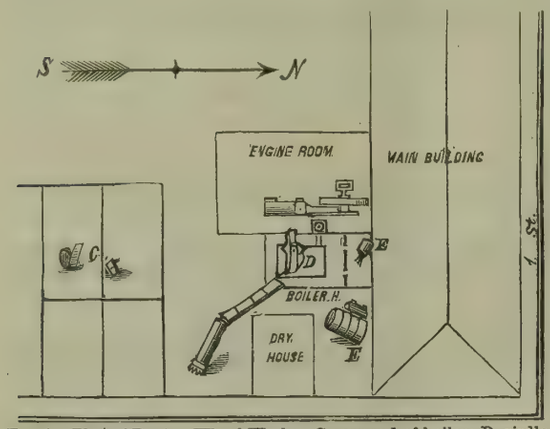


FIG. 1.—Plan of Dayton Wheel Works—C, rear end of boiler; D, girdle of plates; E, front end of boiler; F, boiler No. 1.

Of the accompanying engravings, Fig. 1 represents a plan of the works and the distribution of the parts of the exploded boiler. The main building of the works—a four-story brick structure—with wing and a one-story boiler-house in the angle, is shown in Fig. 2; other detached buildings, forming part of the works, being omitted for the sake of clearness. In the boiler-house above referred to, were the steam generators.

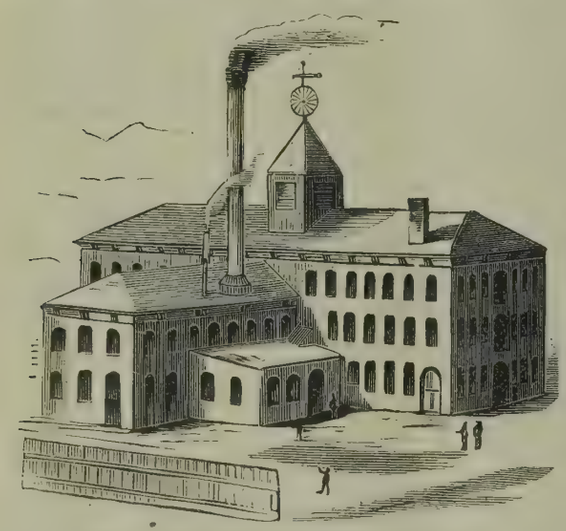


FIG. 2.—Dayton Wheel Works before the Explosion.

They consisted of two horizontal tubular boilers, each 5 feet in diameter by 16 feet long, and each provided with 46 flues, of 4 inches diameter, the full length of the boilers. The disposition of these generators is shown in Fig. 3. Each was further provided with a steam drum 24 inches in diameter by 7 feet long, and with a mud drum 18 inches in diameter by about 6 feet long, as seen in Fig. 5. They had, likewise, the usual attachments, including two steam gauges, one in the boiler-room and the other in the engine-room, connected with the boilers, however, by a common attachment. The water was fed in at the front ends and blown out from the rear ends of the mud drums. Each generator had, also, a 4-inch safety valve, connected independently and directly with the steam chamber, as seen in Fig. 3.

The boilers were comparatively new, having been in service less than a year before the time of the explosion, and were considered to be, in respect to materials and workmanship, first-class. The shells were of (scant) five-sixteenths charcoal iron, with double-riveted longitudinal seams, the iron being represented to have a tensile strength of 55,000 pounds to the square inch, (representing about 15,950 pounds resistance of an inch strip of the shell to tensional strain).

The explosion referred to occurred a little after noon on the 25th of October, and was caused by the bursting of the right-hand boiler. An examination of the *debris* of the exploded boiler, showed that the fracture had occurred along the line A B, Figs. 5 and 8, just below the overlapping end of the plate at one of the longitudinal seams. From this line the fracture had extended irregularly clear around the shell, as shown in Fig. 5, and the force of the expanding water and steam, suddenly released, tore away and flattened out the girdle of plates shown in Fig. 8. The violence of the explosion and its disastrous results, will require no explanation when it is stated that the steam pressure noted a few minutes before the occurrence was about 80 pounds, and that in the neighborhood of 9,000 pounds of highly heated water, suddenly released from pressure, practically flashed into steam instantaneously.

With respect, now, to the cause of the explosion, concerning which no one of those on the scene, or who subsequently examined the case, appears to have come to any definite conclusion, the facts appear to us to indicate nothing mysterious about it. The engineer in charge of the boilers, is reported in the Dayton (O.) *Journal* to have said: "At 12.25 o'clock he had three full gauges of water, and the steam had run down to 75 pounds. In the morning he had carried 90 pounds." Again, after he had directed Rokel (who was shortly afterwards killed by the explosion) to put fuel in the furnaces, so as to keep the fire from dying out, he is reported as having said he "saw that the engine-room gauge showed 80 pounds of steam, and Rokel cried out to me in the boiler-room that the gauge there indicated 75 pounds." He added: "The boiler was scaled pretty thick, and I had tried to get as much of it off as I could, but I think the scales had crystallized, and thus caused the explosion. The boiler always leaked at this place, and I felt that it was dangerous, so it was repaired last week. It was placed in the house last December, and appeared strong."

The repairs spoken of in the engineer's testimony, consisted in calking a longitudinal seam on the side of the boiler opposite to the seam A B, which was the point of the initial rupture. The location of the leak spoken of is indicated at I in Fig. 8, which represents the girdle of plates torn off and flattened out by the explosion. It does not appear that the seam A B leaked before the time of the explosion, but that it was the point of the initial rupture is placed beyond reasonable doubt by the appearance of the plates after the explosion, which showed plainly the existence of a partial fracture, or crack, of older date than the explosion. This fact was plainly visible on the fractured edge, by the presence of a black, oxidized fissure in the plates, extending in places nearly half across the fractured edge, indicating poor iron; and the same appearance was shown at the location of the leak spoken of by the engineer as having been repaired some time before the explosion. The scattered portions of the exploded boiler are shown in the plan, Fig. 1, the rear end having been blown into the yard of a dwelling about 150 feet from the boiler-house. This portion is shown on a larger scale in Figs. 6 and 6′. D, Fig. 1, shows the position of the girdle of plates, which is shown enlarged in Fig. 8; E is the location of the front end, seen enlarged in Fig. 7; and F, Fig. 1, the position of the second boiler, which did not explode, but was turned end for end by the force of the shock.

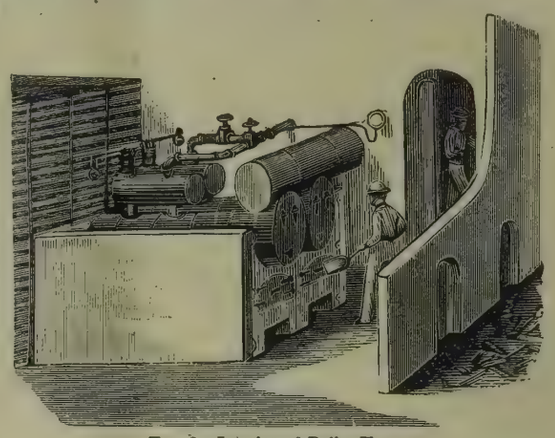


FIG. 3.—Interior of Boiler-House.

The apparent mystification of certain experts who were called on to express their opinion as to the cause of this explosion, in view of the manifest existence of a weak point in the boiler shell, is somewhat surprising, and will scarcely be regarded as satisfying to steam users, who labor under the conviction that good materials and workmanship, frequent inspection, and careful and intelligent management are elements that guarantee safety against disastrous explosions. The following certificate, signed by persons, who, from their business associations, might be supposed to be fully competent to pass judgment in this case, seems to us to be an evidence either of incapacity on their part, or that they could have made only a hasty and superficial examination before so committing themselves. It reads as follows:

FIG. 4.—Boiler Explosion at Dayton Wheel Works.

"We, the undersigned, at the request of Messrs. E. H. Brownell & Co., and Messrs. Pinneo & Daniels, have made a thorough examination of their boiler that exploded October 25, 1881, and find the iron in the boiler to be first-class, made by the Licking Rolling Mill Company, and the workmanship good. We are satisfied that Messrs. Pinneo & Daniels took all due pains and spared no expense in having their boiler fitted up in first-class shape, and had provided more than ordinary means for the safety of their boilers, and cannot see that any blame can be attached to Messrs. Brownell & Co. as makers, or Messrs. Pinneo & Daniels. We find that Mr. Peter Aplin bears the name of

a careful and experienced engineer, and one of the best in the city. By testing one of the steam gauges, we find it worked correctly. We find no indications of low water. We find it impossible to determine the cause of the explosion.

AID COLLINS,
Of the Hartford Boiler Inspection and Insurance Co.
JOHN L. PFAU,
Of the Swift Iron and Steel Works.
J. H. VAILE,
Of Smith, Vaile & Co.
SIMON SPARKS, M. M.,
With Woodsum Machine Company."

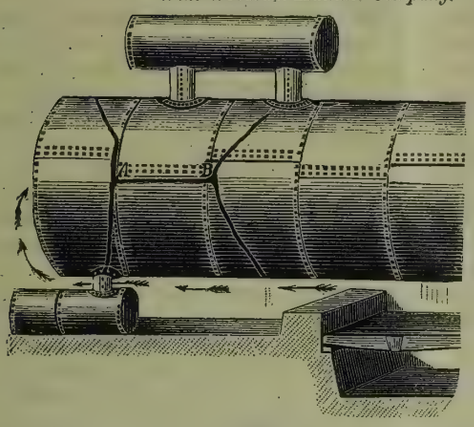


FIG. 5.—Boiler No. 2, showing initial rupture A B, and secondary lines of rupture running round the boiler.

If so surprising a confession of ignorance is allowed to pass unchallenged as the opinion of experts in a case which appears to us to be exceedingly plain and free from mystery, users of steam may well despair of adopting precautions that will render their lives and property safe.

We think that no one competent to pass judgment on the subject, will entertain any doubt, from the evidence contained in the foregoing article, that the cause of this explosion was over-pressure upon a boiler dangerously weak at the line A B, by reason of the use of one or more plates of inferior quality in its construction. The slight bending motions to which the inferior plate, from its location in the boiler shell, would be subjected by alternations of pressure, would be amply sufficient to account for the production of the crack or partial fracture, the existence of which for some time previous to the actual date of the explosion is proved by the appearance of the iron at the seam.

From the evidence presented of the dangerous weakness of the boiler shell at the location of the cracked seam, it seems to us to be altogether unnecessary to assume that a greater pressure than 80 or 90 lbs. was needed to explode the boiler. Nevertheless, it does not appear that any one noticed what the pressure was immediately before the disaster took place. That other incidental defects, in connection with the defective plate, may have contributed to the explosion, is rendered probable by the following considerations:

Although a greater pressure than 80 or 90 pounds is not needed to account for this destruction, yet it is not improbable that the pressure, even with two steam gauges themselves in order, and two safety valves of ample size, might have been much above the indications reported. The gauge pipe common to both gauges being accidentally obstructed is all that we require, together with the faulty safety valves (which are illustrated on an enlarged scale in Fig. 9), to fatally mislead an observer as to the pressure actually endured by the boilers, both of which were in use at the time of the accident. With perfect safety valves, the boilers being sound and good, the hardest firing would not have dangerously increased the pressure, even though the temporary fireman was densely ignorant of the duties of a boiler attendant.

Referring to Fig. 9, it will be seen that the safety valves were broad disks, with three short guide rings and a broad seat. The short blunt stem or teat on which the lever rests, is seen to be very close to the lever pivot—barely two inches. These teats were not turned, and might or might not be in the axis of the valve. If the point upon which the lever rests is not central, then a uniform pressure upon the disk below would raise only the side having the larger radius, and "jam" the rings fast in the seat or guide ring. Once in that plight, the current of steam toward the crescent-shaped opening would impinge on the rings and tend to increase the difficulty without materially relieving the boilers of pressure. One of these valves bore marks of having been jammed in this way so as to bruise the guide rings.

Our only comment on the explosion here considered, is to express surprise that a mystery should be sought to be made of a case that appears to be capable of such simple and satisfactory explanation.

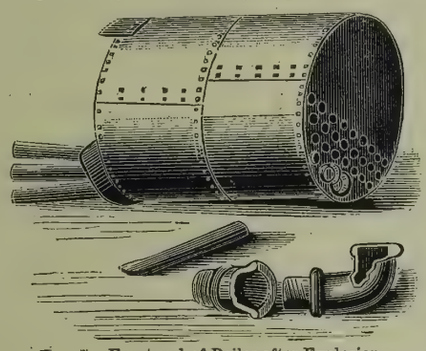


FIG. 7.—Front end of Boiler after Explosion.

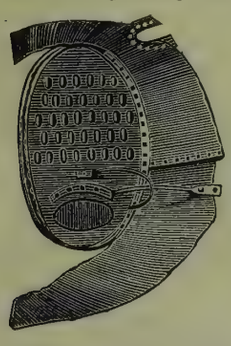


FIG. 6.—Rear end of Boiler after Explosion.

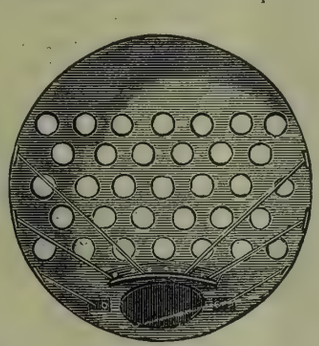


FIG. 6'.—Rear end of Boiler before Explosion.

Reaching the Pole by Balloon.

Commander Cheyne's scheme of reaching the North Pole with the aid of balloons sent up at favorable times from points as near the goal as it is practicable to reach with ships, has lately been made the subject of unfavorable criticism from Mr. Carl Myers, who claims to be an aeronaut of practical experience. He urges certain practical objections, which he considers insuperable, and which are singular enough to warrant mention. We gives these objections in Mr. Myers' own words, and while they may not be absolutely insuperable, they are certainly sufficiently serious to greatly add to the difficulties and uncertainties of Commander Cheyne's speculative undertaking. Mr. Myers says:

"The difficulties opposing the success of such a scheme are twofold: First, those attending the proper inflation and safe ascension of a series of large balloons as proposed; second, a descent within practical distance of the Pole, independent of the chance of ever safely returning. The first of the difficulties I consider insurmountable if attempted at a point very far North, or in the region of extreme cold. Under such conditions the varnish of the balloons would inevitably be as brittle as ice or other frozen matter, and, unless the greatest care was taken to warm them thoroughly, their fragile gas envelopes could never be unfolded and spread out, or otherwise handled, without producing innumerable fissures for the escape of gas. Making heavier or stronger gas bags would not remedy the matter, because only the varnish holds the gas, the office of the cloth being to hold the varnish, just as the netting holds the cloth. Generating a sufficient quantity of hydrogen gas (not less than 50,000 cubic feet) to fill one of these balloons with an Arctic environment, would be attended with difficulties never before known or contemplated in connection with ballooning, and the freshly generated gas, upon meeting greater cold than attended its entrance into the bag, would

FIG. 8.—Girdle of plates torn from boiler No. 2. A B, line of initial rupture; I, locality of leak mentioned by the engineer.

precipitate a certain degree of moisture upon the interior and encrust it with ice, and the bag itself would rupture when changing form by admission of gas during inflation, or by enlarging or contracting by increased or diminished air pressure at different elevations."

Mr. Myers follows these very practical criticisms with another objection, based on the assumption that the tendency of the wind in the region of the poles would naturally be to move away from them toward the sun. This assumption though not unreasonable, is based on purely hypothetical grounds, and may or may not be correct.

Tin in California.

"The *Commercial* of Los Angeles, Cal., reports that an assay of tin ore from the mine discovered near Pomona, showed a result of $89.70 per ton in tin. This mass of tin ore has hitherto been mistaken by prospectors for common rock stained with iron."

The foregoing item is of more than passing interest, since there is strong probability of its truth. There is no doubt that tin exists in considerable quantities in the southern or southwestern portion of California, and that a systematic search would result in the discovery of deposits that would amply repay working them. The tin mines of Temescal, of which so much was expected some years ago, are located in the neighborhood of Los Angeles, a fact which renders the truth of the above report probable. Tin, as we have several times had occasion to state, is one of the great wants of this country.

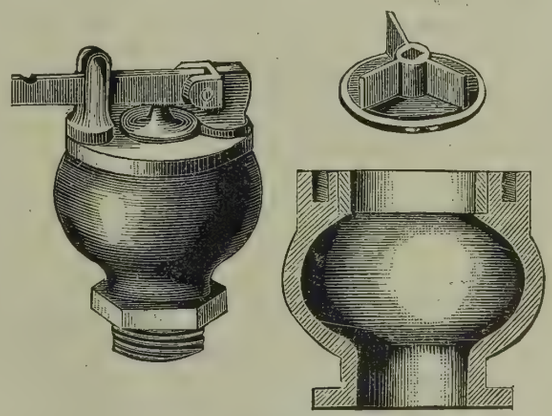


FIG. 9.—Details of Safety Valve.

THE USE OF SALICYLIC ACID for the preservation of articles of food, has been forbidden by the French government. This action is based on the allegation, which is claimed to be proven, that this substance is dangerous to health when used in sufficient quantity to effect the object of preserving food.

Scientific.

Dangers of Electric Lighting.—We give below the full text of the report of a committee of the Franklin Institute on the precautions to be taken to obviate the dangers incident to the methods of electric lighting in vogue. This report is a very timely contribution to a subject that is now attracting much attention, and on which the general public are very much in the dark. The report is in most respects a very sensible document, dealing with the subject in a straightforward, practical and readily comprehensible manner, and will be read with profit by all who take an interest in electric lighting.

We can only take exception to one point in the report, namely, the omission of the committee to insist that the wires should be carried under ground wherever this is possible. This disposition of the wires is possible in almost every case where the wires are now stretched overhead in the streets of our cities. The committee state, it is true, that to avoid endangering human life the conducting wires should be placed out of reach—which may be interpreted to include the burying of them beneath the ground; but a direct recommendation to that effect would have been putting the institution on record as favoring the only practicable method of dealing with the multiplication of wires that the future has in store for us. The committee consisted of R. E. Rogers, Chairmair; Charles M. Cresson, M.D.; David Brooks, E. Alex. Scott, Edwin J. Houston, and Isaac Norris, M.D., Secretary. The follow is their report in full:

That from a careful consideration of the evidence submitted, they believe that the use of electricity as an illuminant, as now generally employed, is not attended with any dangers, either to person or property, that cannot be obviated by the adoption of the precautions hereinafter set forth.

In order that the reasons which give rise to the necessity for these precautions may be the more thoroughly understood by the general public, for whom they are designed, the committee believe that the following statements of the general principles involved in systems of electric lighting, as now practiced, may not be amiss. There are two systems of electric lighting now in general use, namely, the incandescence system and the arc system. In the incandescence system an electric current, flowing through a thin wire of platinum, or other difficultly fusible metal, or through a thin filament of carbon, heats it by incandescence to nearly a white heat, by reason of the resistance it offers to the passage of the currents. In the arc system, an electrical current flowing from one rod of hard carbon to another, heats the rod sufficiently to cause a stream of carbon vapor to pass between them. This vapor, heated to intense whiteness by the electricity, forms what is known technically as the "voltaic arc." In the incandescence system it is necessary, in order to prevent the rapid destruction of the wire, or carbon filament, to surround it completely by a glass globe or cover from which all the air has been removed. In this system, therefore, external objects cannot come into contact with the source of light. In the arc system it is not necessary to exclude the atmospheric air from contact with the carbons, or electrodes, as they are sometimes called. Arc lights are, therefore, burned in the open air. They are generally much brighter than incandescent lights, and are, in practice, usually surrounded by a globe of glass, in order to lessen the intensity of the glare. They can, however, be placed in a globe from which all the air has been removed, since the light produced is not dependent on the burning of the carbon electrodes—that is, on their combustion.

The source of the electricity employed in all systems of lighting is the dynamo-electric machine. This machine produces, more cheaply, a current whose properties are similar to the current obtained from the ordinary voltaic battery. In the dynamo-electric machine, mechanical energy, derived from a steam engine, water wheel, or any other suitable source, is converted directly into electrical current. The change of mechanical into electrical energy is obtained by the motion, past powerful magnets, of a number of coils of insulated wire wrapped on a core of iron. The core so wrapped is called the armature. The armature moves close to the poles of the magnets already referred to, but does not actually touch them. There is, therefore, no friction in the dynamo-electric machine as in the ordinary electrical machine. The attraction of the magnet poles tends to hold the armature in fixed positions. Mechanical power is required to move it out of such positions, and when so exerted is converted into electrical currents, which flow through the coils of wire on the armature. The current in the armature flows alternately in different directions through the wire wound thereon. It is generally caused to flow constantly in one and the same direction by means of a contrivance called the "commutator." The current so produced flows out of the machine, through a conducting wire, into and through a number of lamps placed at suitable points in the length of the wire, and finally through a continuation of the wire back to the machine. The path of the current from the machine to the lamp, and out of the lamp back again to the machine, is known technically as an "electric circuit." Any conductor is said to be placed in an electric circuit, or to form part of an electric circuit, when it is so arranged that the current from the machine or battery causing the electricity, can flow through it and back again to the place where the current was produced. That is, anything placed in an electric circuit forms part of the conducting path through which the current is circulating.

Dynamo-electric machines are now made to furnish very powerful currents—currents capable of sustaining fifty or more arc lights in one circuit or line. Such currents require care in their management and judgment in their introduction into buildings or public places for purposes of illumination. Fortunately, however, the currents produced by dynamo-electric machines have some properties very different from those produced by the ordinary frictional machine. The former possesses little or no power of leaping from one conductor to another across an intervening non-conductor, such, for example, as air; the latter can, as is well known, readily so pass—often through several feet or more of dry air.

The currents from dynamo-electric machines, or the currents employed in systems of electric lighting, are not, therefore, at all comparable to the strokes of lightning, to which they have often been ignorantly likened. Lightning discharges frequently pass through miles of air, but, even in the largest machines, the carbons employed in arc lamps must first be brought into contact and afterwards separated, before the arc is established and the current passes between them. The current will not, in fact, leap through the air. The momentary contact of the two carbons develops sufficient heat to form a cloud of carbon vapor between them, and this cloud, being an electrical conductor, permits the current to pass. When, however, the cloud of vapor is once established between the two carbons, it will continue to pass until the carbons are sufficiently consumed to cause the distance between them to become too great be bridged over by the vapor. While, therefore, the current possesses little or no power of so leaping through air, yet it is necessary that no opportunity be afforded it to form such conducting clouds between it and neighboring conductors. A brief mention of some of the ways in which such clouds may be formed will, therefore, be of practical importance.

If two bare metallic wires, conveying powerful electrical currents from different sources, be brought into contact and then gently separated, a cloud of metallic vapor may be formed between them, as in the case of the carbon electrodes. Or if any portion of a bare wire be brought into contact with one part of a metallic conductor, and a distant part of the same wire again touches this conductor, an arc of flame may be established between the wire and conductor. To speak more generally, if any conducting material be placed in, or form a part of the electrical circuit, and from any cause a momentary break be made between it and the rest of the circuit, an arc of flame may result. As these arcs of flame are very hot, their occurrence should be carefully prevented in all places except between the carbon electrodes in the lamp. Dangers of this character may be entirely avoided by carefully insulating all the wires which carry the electrical current into or out of the building or space to be lighted. The comparatively feeble leaping power of the currents developed by dynamo-electric machines, as already referred to, does not however necessitate any very high degree of insulation for the wires. Whatever the character of the insulation employed, care should be exercised to insure its being preserved intact on all parts of the wire. The removal of the insulation from but a few points of the wire might cause a dangerous discharge at such points.

When two different paths are open to the current, it will flow through both such paths. If these paths are of different conducting powers, more current will flow through the path which is the better conductor. If one of the paths be twice as good a conductor as the other, twice as much current will flow through it. If it be a hundred times a better conductor, a hundred times more current will flow through it; and so for any other proportion. In other words, the currents will be divided between the different paths in proportion to their conducting powers.

Suppose, now, that two different portions of an electrical circuit be bridged over by any conducting material. Say, for example, that a wire from a line of telegraph or telephone falls across a line of electrical conducting wires, so as to connect the wire carrying the current from the machine with a part of the wire carrying the current back to the machine. If such electrical conducting wire be uninsulated, a series of cross contacts would thus be formed, and two different paths be opened to the current. Since the conducting power of the short wire, forming the cross circuit, would probably be far greater than that of the portion of the circuit with its included lamp, the greater part of the current thus "cut out" or "short circuited" would pass through the cross wire, either fusing it, or drawing dangerous arcs of flame when the contacts were at times but partial.

This danger may be entirely obviated by insulating the wire. It is, therefore, preferable to insulate all parts of the wires that lead either from or to the machines producing the current. If the human body be accidentally placed in the circuit, the partial or entire passage of the current through it may, if the machine be powerful, cause instant death, or, if the machine be of smaller size, produce a painful shock. But to enable the current so to pass, the body must be placed in the circuit of the machine—that is, the current must be able to enter the body at one point and to pass out and back to the circuit from another point; or, in other words, a break must be made in the wire and the body inserted in this break.

Here again the difference between the current from dynamo-electric machines and from the common frictional machine, is to be carefully noted. Merely touching any part of a charged conductor of a frictional electric machine, will completely discharge it, the person conducting the discharge through his body to the ground. A person touching any part of a bare conducting wire while it is conveying a powerful electrical current, such as used in systems of lighting, would not convey the discharge through his body to the ground, because he would not be placed in the circuit. He has simply provided a place for the current to enter, but none for it to flow through him and back to the machine whence it originated. Should, however, one portion of the wire touch the ground in any place, especially where it is wet, then his feet might be connected through the damp ground with another part of the circuit, and two paths thus be opened to the current, with the chances of a dangerous portion thereof passing through his body.

To guard against dangers of this character, it is necessary to thoroughly insulate the wire in all places where it is liable to be touched. It is far preferable to establish a continuous metallic line of conductors both to and from the machine, rather than ground the wires, and so necessitate the current to pass through the earth in order to flow back to the machine.

During the burning of lamps of the arc type, fragments of highly heated carbon sometimes become splintered from the electrodes and fall below. To avoid danger from this source, a cup should be placed below the electrodes to receive any fragments that may fall.

It would follow, from the principles thus briefly enunciated, that there may arise two kinds of dangers from the employment of powerful electrical currents for the purposes of artificial illumination, namely, dangers to property from fire, and dangers to life. With the exception of that due to falling fragments, all these dangers may be readily and completely avoided by properly and thoroughly insulating the wires that carry the current to and from the machine, while that due to falling fragments may be easily avoided by the means above pointed out. In order, however, to particularize these different kinds of dangers, and to point out more especially the proper remedy for the avoidance thereof, the committee recommend that the following precautions be taken in all cases where electric lighting is employed:

1st. That the conducting wires leading into and out of the building be suitably insulated throughout their entire extent, both to and from the machine producing the current.

2d. That an inspection be made at suitable intervals to determine whether or not the insulation has been preserved intact. The insulation may become impaired by the following causes: By the wires being cut by the staples or hooks used in securing the conducting wires in position; by the wires being placed in positions subject to abrasion, either by chafing with another wire, or from any other cause; by the wires turning sharp bends, or by being sharply bent by any cause whatever.

3d. That conductors formed of numerous short pieces of wire be avoided as far as possible, and that where their use is necessary the joined ends be made as secure as possible by wrapping, so as to prevent short arcs being formed at imperfect junctions, should the joined ends be partially separated from each other.

4th. That the wires be not grounded—that is, that no attempt be made to cause the current to pass back to the machine through the earth, but that a continuous line of wire be provided, through which the current shall so return. In order that this precaution may be effective, the wires should not be carried near metallic bodies like lines of shafting, nor gas or water pipes, because an accidental contact of the conductor with any of these would effectually ground that part of the wire. Where it is necessary that the wire cross such metallic bodies, it is advisable that the insulation be made better than usual at such junctions.

5th. That the ready occurrence of cross contacts or short circuits be avoided, as follows: That the conducting wires from different machines, or from different parts of the same machine, be kept as far apart as convenient, and never, except when necessary, be brought nearer together than the distance between the two binding posts on any electric lamp used in the circuit. That, therefore, the wire leading from the machine into the room to be lighted, should leave the room as far as convenient from the place it enters. That the wires be securely fixed in position, and be not allowed to sag or bend in wide curves, except where it is necessary to permit the raising or lowering of the lamp. That judgment be exercised in selecting the portions of the building in which to run the wires. To secure as far as possible the absence of moisture, ceilings are to be preferred to walls or floors, the latter being highly objectionable unless the wires are placed under the flooring. As before stated, the location selected should be removed as far as possible from metallic conductors. Select the places least liable to be rendered partially conducting by moisture from any source, in which to run the wires.

6th. That the conducting wires be of sufficient size to carry the most powerful current employed, without dangerous heating.

7th. To avoid the danger to life from the accidental discharge of the current through the body, the conducting wires should in all cases convenient be placed out of reach, either by choice of location or the use of heavy and guarded insulation.

8th. That where lamps of the arc type are used, they be covered with a globe of glass, and that the lower end of such globes be furnished with a cup or pan for retaining any heated fragments.

The committee believe that if these precautions be taken, electric lighting can be thoroughly safe and reliable, and that all dangers attending its use can be entirely obviated.

Poisonous Qualities of Pyrogallic Acid.—It will be a matter of interest to all who are engaged in photography to learn from the results of recent experience, that pyrogallic acid is possessed of decidedly poisonous properties, and that considerable danger attends its use. The subject has quite recently been fully ventilated in the medical journals, in which the records of certain cases were presented and discussed, which proveo beyond peradventure that pyrogallic acid possessed certain properties hitherto quite unsuspected, and which demonstrated that this substance, even when applied externally, may act as a violent poison, causing death by its great affinity for oxygen.

Dr. T. L. Phipson sends to the *Photographic News* an interesting communication on this subject, of which we give the substance in the following: Physicians who were unacquainted with the energetic deoxidizing properties of pyrogallic acid, have proposed it as a substitute for chrysophanic acid in the treatment of skin diseases. Its use for this purpose, however, in the light of a recent case of poisoning from an ointment of pyrogallic acid which occurred in the Breslau Hospital, must be abandoned. Dr. Neisser, who reports this case, gives the following account of it: A man of strong constitution was admitted to one of the wards of the hospital to be treated for general psoriasis (a disease commonly known as "dry tetter"). It would appear that he was made the subject of an experimental treatment to test the curative properties of pyrogallic acid as compared with chrysarobine. One half of the body was treated with a pomade containing one of these substances, and the other half with the other compound. Within a few hours after the application, the patient was seized with dangerous symptoms—shivering, vomiting and collapse. On the fourth day the patient died.

Experiments were at once instituted on rabbits, which proved that the death of this patient was due entirely to the pyrogallic acid, and that the chrysarobine was quite harmless. In some cases the rabbits died within two hours. *Post mortem* examination of the hospital patient revealed the fact that death was caused by the deterioration of the blood, the red corpuscles having been destroyed and turned brown, which gave to the fluid a dirty brownish-red tint.

Photographers should, therefore, be exceedingly cautious in using this reagent, which is shown by the above to be possessed of active and fatal poisonous qualities.

Solvent Action of Canned Food on Tin.—This subject has lately been carefully investigated by Helmer, who announces through the London *Lancet*, that tin, even when quite pure, is much more readily attacked by canned articles of food than is commonly supposed. He has made an examination of a large number and a great variety of such canned goods, and has found tin in comparatively large quantities in nearly all of the samples examined.

As examples, he states that acid fruits, such as peaches and cherries, corrode the metal to an alarming extent; but what is even more serious, he found that meats, and even condensed milk, take up and become contaminated with sensible quantities of the metal. He instances the case of a can of soup, which he found to contain 35 milligrams (about ½ grain) of tin to the pound; one of condensed milk which carried 8 milligrams (⅛ of a grain); and one of oysters, which contained 45 milligrams (about seven-10ths of a grain) to the pound. He found also that soda water, and all other varieties of aerated beverages which he examined, and which were conducted through tinned pipes, contained appreciable quantities of tin.

Having established the above facts, we come now to the more directly interesting and important question, whether tin is injurious to health. On this point there appears to be still some room for doubt. To settle the question, Helmer made a number of experiments upon pigs, the results of which went to prove that while *stannic* compounds are harmless, *stannous* compounds acted as decided irritant poisons. As the tin dissolved in the various forms of prepared foods would exist in this latter condition, the above statements become decidedly important.

Electricity on the Elevated Roads.—Mr. Siemens, the well-known inventor of the electrical railway motor which is now in successful operation near Berlin, has undertaken a trip to this country in the hope of inducing the directors of the New York Elevated Railroad to adopt his device for propelling their trains. It is reported that several of them are already favorably impressed with the proposition, and a trial will doubtless be made before long to determine the working of the motor on the New York line, which, although unlike Messrs. Siemens & Halske's road in some respects, can, Mr. Siemens thinks, be adapted without difficulty to the electrical system. It is much to be hoped that the experiments will be successful, and that the new source of power will take the place of steam on all the elevated railroads. The saving of annoyance, not only to the occupants of houses along the avenues and streets, but to the passengers in the cars, would be enormous, and if Mr. Siemens' anticipations are realized the companies will secure a considerable economy of expense. Their directors, indeed, appear to have been only waiting for more definite assurances of the practicability of electrical propulsion to take up the subject seriously. One of the relatives of Mr. Cyrus W. Field has within a year or two taken out several patents for improvements in electrical motors, and the experiments of Mr. Edison at Menlo Park, N. J., have been watched with interest by capitalists, so that if a feasible scheme should be presented, it would without doubt find ready acceptance.

Concerning Actinium, the new element, whose discovery and identification by Dr. Phipson we recorded in our December number, it may be said that the opinion among chemists is very largely in favor of the genuineness of the discovery. The remarkable thing about it, however, is the fact that Dr. Phipson has found it present in comparatively large quantity—as much as 4 per cent—in certain kinds of commercial zinc; and the mystery is that it should so long have escaped the notice of chemists. The *Chemical News*, one of the leading journals devoted to chemistry, in an article discussing the discovery of Dr. Phipson in favorable terms, states that the quantity of actinium sulphide obtained from the white pigment amounts to no less than 4 per cent. This yield is enormous. The presence of this new element in zinc will account, probably, for the discrepancies noticed in the equivalent of this metal, as determined by various observers. It exists, evidently, in considerable quantities in some kinds of commercial zinc.

A Curious Electrical Experiment is described in one of the French journals as follows: A small pasteboard box is provided with a glass lid, which is coated on the upper surface with one or more thin layers of collodion, but not enough to render it opaque. A number of figures representing insects and the like, and made of cotton or sponge, are placed within the box.

When now the collodion surface is rubbed with the dry fingers in dry weather, the insects are made to move about in an interesting manner, as they become electrified.

Printing Plates of Celluloid.

One of the latest applications of the remarkable material known as celluloid, and one that promises to become in time very useful and valuable, is its employment in the preparation of printing surfaces, as a substitute for the common stereotype and electrotype. At common temperatures, celluloid is an exceedingly tough, highly elastic substance, possessing sufficient hardness to withstand the roughest usage in the press, and being at the same time quite indifferent towards most chemical reagents, it is affirmed that it can be used with great success in printing with the most sensitive and brilliant colors, for which the copper-faced electrotype or the stereotype could not be employed, because of the chemical action of the metallic surfaces upon the colors.

SPECIMEN OF CELLULOID PRINTING PLATE.

Celluloid possesses the property of softening or becoming plastic at a moderate temperature, a property which is taken advantage of in the numerous applications of the substance to mold or press it into various shapes and forms. In the production of printing plates, this property is likewise made use of to press, with suitable appliances, a sheet of celluloid, properly softened with the aid of heat, into the surface of the engraving or a plaster cast of the same, or a page of type to be copied. When removed, and cemented to a block of wood type-high, the celluloid printing plate is ready for the press. The operation, as will be inferred from the foregoing statement, is an exceedingly simple one. When it is not important whether the lines of the print should be reversed, the celluloid plate may be prepared directly from the engraving or object to be copied. In copying samples of lace and other delicate textures, leaves, ferns, and many other materials and objects, the impression is made directly by pressing the object to be copied into the surface of the plastic celluloid. The plate then requires simply to be cemented to the wooden block to be ready at once for the press. Such blocks being taken directly from the object, are absolutely correct fac-similes, such as could only be approached by photography.

By this means the most delicate lace patterns are reproduced cheaply, and with the greatest ease and the most exquisite detail; and leaves, ferns and the like with all their delicate veining. The total absence of "grain" in the celluloid renders it possible to secure a perfectly smooth, glassy surface, from which these exquisitely delicate impressions can be printed far better than from a metal surface, even were it possible to produce such results in metal. The utility of the celluloid plates for producing fac-similes of the most delicate textile fabrics, prints of which can be mailed as samples, and the advantage they afford in the preparation of plates for illustrating many subjects of natural history, are too obvious to require more than mention.

The durability of the celluloid printing plates is represented to be considerably greater than that of metal plates, this superiority being due to the great toughness and elasticity of the substance, which resist the breaking-down and wearing of the fine lines in the press. The impressions yielded by the celluloid plates, also, by reason of the perfectly smooth surface of the substance in the raised portions, are affirmed to be very much superior to anything that can be obtained from metal stereotypes or electrotypes. We have seen prints of lace patterns taken from plates prepared by direct impression, that were simply exquisite, and far ahead of anything that could be produced in metal by the processes now in use. The fact that the celluloid plates can be used with the most delicate and sensitive colored inks has already been mentioned.

A plate of this kind is shown in the accompanying illustration, from which an idea of the extreme delicacy of the work it is possible to execute in celluloid may be had. This work is now being done by the Celluloid Stereotype Company, of No. 11 Frankfort street, this city.

We regard this latest adaptation of celluloid as being among the most useful and valuable of the applications of this remarkable substance, and anticipate that it will soon come into very general use.

Glucose in Beer-Making.

Several of the leading newspapers have lately contained lengthy articles on the wholesale adulterations alleged to be practiced by the brewers of beer in the manufacture of this popular and universally consumed beverage, and denouncing the product of most of our breweries as unwholesome and dangerous. The New York *Sun* lately devoted a lengthy article to this subject, in which it demonstrated to its own satisfaction that "the modern article (beer) scarcely retains anything of the old-time fluid beyond the name;" that our brewers are given to the wholesale use of substitutes for both malt and hops, and that in consequence of the unwholesome character of their products, there had been of late years an alarming increase in the number of deaths from kidney disease. The Philadelphia *Times*, in a similar strain, devotes a lengthy editorial in a late issue to prove that the liquid we have hitherto supposed to be beer is in reality a species of "slops," with nothing of beer about it save the name—"a mere fermented infusion of corn-meal, aloes, cocculus indicus, and occasionally strychnine."

We do not think that any of these writers will seriously endeavor to make good the charge that any of our brewers habitually employ any substitute for hops. This charge is insinuated rather than openly expressed, and for that reason may be passed by. We are specially interested in the denunciation of the use of malt substitutes, and especially of glucose in beer-making. The use of these malt substitutes is openly acknowledged by many brewers, and we think that a consideration of this subject may interest many of our readers. That our comments may be better understood, we give herewith a portion of the *Sun's* article relating to the use of glucose:

"The beers made from corn and rice mixtures with malt are generally light colored, bright, and have a good head—thanks for the latter to their uncompleted fermentation and the large quantity of bicarbonate of soda customarily put into them—but neither their flavor nor their effects upon the drinker are the same as afforded by the true barley malt beer. In some of them the corn flavor is very pronounced, and thus far no attempts to give to them by chemical art the distinctive barley malt flavor have been really successful. The most frequently employed device for the attainment of that flavor has been by the addition of slightly roasted starch to the finished beer; but the success of that treatment has been rather a matter of imagination than fact. Rice beer has not so strong a flavor of the grain as that made from corn, but what it lacks of force in that direction it makes up by its power of compelling headaches and nervous disorders, for which it is even mightier than the corn product. The substitutes for barley malt are not confined to the cereals, but include also potato starch, corn starch, and glucose. The first of these three articles has not been used much in this country, as it has been found to be more cheaply replaced by the others. Glucose has come into very general use. This syrup is made from corn, which for its production is treated with either sulphuric or oxalic acid. The extent to which the former acid is directly injurious to the consumers has not been fully determined by medical men; but about the latter there is no question, its poisonous character being fully known. Of course the glucose manufacturers aver that neither acid is left in the finished syrup in such quantity as to

be at all injurious, but that is by no means a determined fact. Taking the process with sulphuric acid—the least deadly of the two at all events—it is not absolutely reassuring to the intelligent glucose beer-drinker. The corn is boiled in water containing two per cent of sulphuric acid, either in open vats or under pressure—the latter facilitating the process until complete conversion has taken place, a result which is determined by the tincture of iodine test. Then it is evaporated in vacuum pans to a specific gravity of about 40° Beaumé. The sulphuric acid is supposed to be expelled by the use of carbonate of lime, which combines with it and forms the salt sulphate of lime, most of which is deposited at the bottom of the vat. This salt is difficult of solution, but is not absolutely insoluble in water, and its solubility is greatly increased in water which contains saccharine matter, as the glucose, so that much of it remains in the finished product put upon the market. In starch factories glucose is also made as a bi-product, and in some instances is produced, not from the starch, but from the refuse that is unfit for conversion into marketable starch. Grape sugar is simply glucose from which the water has been expelled until it has been made a solid, and is little employed by brewers, as its use involves the trouble of re-dissolving it. In whichever form it appears, the glucose of commerce almost invariably contains a certain percentage of the sulphate of lime, and it is claimed by expert chemists that this salt, and the lack of a proper proportion of nitrogenous matter in a glucose, most materially affects the healthful development of the yeast cells in fermentation, thereby encouraging the formation of bi-products which are detrimental to the human system."

The article from which the foregoing quotation is made, concludes with the evidence of several well-known physicians and chemists, going to show that there has of late years been "an alarming increase of renal (kidney) disorders." From which we are to judge from the context that beer is the responsible cause.

Our purpose in the following remarks is to express our belief, and to give our reasons therefor, that this outcry against the use of malt substitutes, and especially of glucose, in the fabrication of beer is a good bit of a bugaboo. There is not a single well substantiated fact to warrant the assertion that the reinforcement of malt with rice, corn or glucose, which is known to be practiced to a considerable extent, produces a product possessing positively injurious qualities. The products of the fermentation of such mixtures contain nothing but the elements that are present in a normal beer. The finished products may, and doubtless do, differ slightly in their proportions of these elements—may contain a little more or less of alcohol, of albuminous substances, of carbonic acid, and the like, but not a single constituent that cannot be found in a normal beer, or that is not acknowledged to be an essential constituent.

We do not wish to be understood as recommending the use of these substitutes. On the contrary, we hold the opinion that no grain can equal barley malt in the preparation of a fermented drink, its proportions of saccharine and albuminous elements fitting it admirably for the production of a beverage that shall be at once nutritious and gently stimulating. But we affirm, without fear of successful contradiction, that the use of grains in connection with malt will produce a fermented drink quite as wholesome as a normal beer made exclusively of barley malt and hops, and probably more agreeable to the taste of nine out of ten who drink it than the latter.

On similar grounds, the use of a small proportion of glucose or corn sugar as an accompaniment of the malt, so far from deserving the unreasonable denunciation it has received from certain sensational newspaper writers, produces a fermented beverage which no one has yet succeeded in proving to be less wholesome than a normal beer, and which is universally admitted to be decidedly more palatable than the latter. It has been asserted that the continuous or excessive use of beer containing glucose and the products of its fermentation brings on death in the form of kidney disease. The *Sun* in particular, gives the testimony of a number of well-known physicians, all of whom agree in stating that they have noticed in their practice an enormous increase of renal (or kidney) disorders within the past ten years. The obvious inference which the *Sun* would have its readers draw from these statements, by the context, is that glucose in beer is the cause and kidney disorders the effect. But the distinguished physicians referred to in the *Sun's* article, are very careful not to place themselves on record as making such an assertion.

But the inquiry naturally follows, if glucose in beer is not the cause of the enormous increase of kidney disorders, What is the responsible cause? We think it is to be found in the fact, which is freely admitted by some of the best medical authorities, that physicians as a body have only lately come to properly understand and recognize the symptoms of many forms of kidney disorders within this period. Quite a number of disorders which were until quite lately classed as independent diseases, and which played an important *role* in the mortuary records, are now known to be simply the symptoms of one or another form of kidney disease. It is unnecessary for our present purpose to specify more than one of these—dropsy—to establish the point we wish to make. The positive recognition that has lately been made that dropsy and other disorders (which we have not named, because they are not so well known to the general public) are not independent diseases but simply symptoms, or consequences attending various forms of diseased kidneys, has been followed, naturally enough, by the withdrawal of the names of a number of these symtomatic disorders from the mortuary records, and the substitution of the name of the real disease. These facts are universally admitted by leading medical authorities, and can readily be substantiated by any one who is sufficiently interested in the subject in hand to make inquiry into their truth. Viewed from this standpoint, the seeming mystery surrounding the cause of the alarming increase of renal disorders within the past ten years, becomes intelligible.

In conclusion, we cannot refrain from alluding to the fact that while the newspapers have indulged in unlimited condemnation of the use of glucose in the fabrication of beer, they have, with singular obtuseness of vision, ignored, or passed by without notice, the facts respecting the enormous use of glucose in other arts besides that of brewing, and the enormous consumption of this material by people of all ages and both sexes under the guise of sugar, molasses, syrups and candies. In these forms, it is safe to say that considerably more glucose is consumed by our population than in beer. It is an open secret to the initiated that glucose is used in immense quantities by confectioners and candy-makers in place of cane sugar. In this branch of industry, in fact, the use of glucose has become almost universal. The products of our candy shops, which can only be reckoned by millions of pounds annually, are consumed by millions of people, and especially by growing children and women, who are notoriously fond of sweets, and eat them without stint. The vital organs of children, as we all know, are peculiarly sensitive to injurious influences, yet they appear to be able to digest and assimilate glucose candies with impunity, for we have yet to hear of any "alarming increase of kidney disorders" among children. If glucose is really the hurtful substance that some would make it appear, surely it is reasonable to suppose that its evil effects should appear in aggravated form among our children, as a consequence of their unlimited consumption of it in the form of candies. But we have no evidence that such is the case, from physicians or laymen, and the consumption of glucose in this form goes on without let or hindrance or protest from newspapers that can devote columns in unmeasured denunciation of its use in the manufacture of beer.

Immense quantities of glucose are known to find their way into the market in the form of an adulterant of cane-sugar syrup or molasses, which is an article of almost universal consumption; but no newspaper writer has had the keenness of vision to detect any terrible consequences from its use in this form. In a similar strain we might dwell upon the vast and growing use of "new process" sugars—a name which is known to disguise a mixture of cane sugar with dried glucose; but we have said enough, we trust, to assure our readers that the moderate use of certain malt substitutes, and especially of glucose for the reinforcement of malt in beer-making, need give them no alarm, and that the wholesale denunciation of glucose in beer-making which certain newspapers have indulged in, is quite unwarranted by facts.

Domestic Sugar Production.

From Mr. Lewis S. Ware's late publication, entitled a "Study of the Various Sources of Sugar," which we noticed in our bibliographical department a few months ago, we glean the fact that the value of the sugar imported into the United States is greater than that of any other single article of commerce. In the year 1880, statistics show that the astonishing quantity of over 1,829,000,000 pounds of sugar were imported into this country, at a cost of nearly $120,000,000. The average yearly consumption *per capita* during the decade from 1860 to 1870 was about 28 pounds; but in the ten years following it had risen to 38 pounds, an increase of about 35 per cent in ten years, and is steadily on the increase.

The sugar production of the world is estimated by the author, from statistics, to be about twelve billion pounds per annum. Of this total production, about three-fourths is derived from the sugar cane, and the other fourth chiefly from the sugar beet. The United States produce only about one-seventieth of the total product, the same being derived chiefly from the sugar cane cultivated in Louisiana. Beet sugar is almost exclusively produced in Europe, the following countries in the order named being the chief producers of sugar from this source—France, Germany, Russia, Belgium, Austria, Holland, Sweden and Italy.

Mr. Ware has no confidence in the sorghum and other canes that have been experimented with for years in Northern temperate countries, and he concludes his consideration of the subject with the declaration that the sugar beet is the only practicable source of sugar for the Northern States, which, as he shows, can be raised at a profit of forty-six dollars per acre, as contrasted with twenty dollars per acre—the profit of sugar-making from cane in Louisiana. Several beet sugar factories have been established in the United States and in Canada, and their products are reported to have been quite satisfactory as to quality, and have been sold at a profit in competition with imported beet sugar.

The difficulty hitherto encountered in the attempts to establish the beet sugar industry, has been the absence of the requisite skill. With this difficulty removed, there would be no trouble in establishing the industry on a profitable basis throughout all the Northern States. This fact has now come to be generally acknowledged, and the domestication of this important industry is conceded to be now only a question of a few years.

Improved Tin Cans for Preserved Foods—It is stated that a very simple and neat improvement has been effected in the preparation of the tin cans now so extensively used for preserved foods. The body of the can has a beveled rim, upon the slope of which the cover is soldered. When the cover is smartly tapped round the edge, it is expanded, and the solder joint broken by the wedge action of the bevel. The can is thus opened without injury to the lid, while the present inconvenient and even dangerous process for cutting open these air-tight cases is entirely avoided. The improvement involves no additional cost, and the soldering is applied externally.

Latest Market Report of Building Materials.

NEW YORK PRICES.

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LUMBER.

Pine, very choice and extra dry, per M	$60 00 *a* 70 00
Pine, good	55 00 *a* 60 00
Pine, shipping box	21 00 *a* 22 50
Pine, common box	18 00 *a* 20 00
Pine, common box, ⅝	16 00 *a* 18 00
Pine, tally plank, 1¼, 10 inch, dressed, each	44 *a* — 50
Pine, tally plank, 1¼, 2d quality	35 *a* 38
Pine, tally plank, 1¼, culls	28 *a* 30
Pine, tally boards, dressed, good	30 *a* 32
Pine, tally boards, dressed, common	25 *a* 28
Pine, tally boards, culls, dressed	23 *a* 25
Pine, strip boards, merchantable	18 *a* 20
Pine, strip boards, clear	24 *a* 26
Pine, strip plank, dressed, clear	33 *a* 35
Spruce boards, dressed	25 *a* 27
Spruce plank, 1¼-inch, dressed	28 *a* 30
Spruce plank, 2 inch	43 *a* — 44
Spruce wall strips	15 *a* — 16
Spruce timber, per M	20 00 *a* 25 00
Hemlock boards, per M	17 00 *a* 18 00
Hemlock joist, 2½x4, each	16 *a* — 17
Hemlock joist, 3x4	18 *a* — 20
Hemlock joist, 4x6	40 *a* — 44
Ash, good, per M	55 00 *a* — —
Oak	60 00 *a* 65 00
Maple culls	25 00 *a* 30 00
Maple good	45 00 *a* 50 00
Chestnut	48 00 *a* 52 00
Cypress, 1, 1½, 2, and 2½-inch	35 00 *a* 40 00
Black walnut, good to choice	115 00 *a* 125 00
Black walnut, ⅝-inch	85 00 *a* 100 00
Black walnut, selected and seasoned	150 00 *a* 175 00
Black walnut counters, per ft	22 *a* 28
Cherry, wide, per M	100 00 *a* 120 00
Cherry, ordinary	60 00 *a* 80 00
White wood, inch	45 00 *a* 50 00
White wood, ⅝-inch	35 00 *a* 40 00
White wood, ⅝ panels	45 00 *a* 50 00
Shingles, extra sawed pine, 18-inch	4 00 *a* 5 00
Shingles, clear sawed pine, 16-inch	3 75 *a* 4 00
Shingles, cypress, 24x6	18 00 *a* 20 00
Shingles, cypress, 20x6	10 00 *a* 12 00
Lath, Cargo rate	2 00 *a* — —
Yellow dressed pine flooring	30 00 *a* 40 00
Yellow pine girders	32 50 *a* 40 00
Locust posts, 8 feet, per inch	18 *a* 20
Locust posts, 10 feet	24 *a* 25
Locust posts, 12 feet	29 *a* 34
Chestnut posts, per ft	3 *a* 3½
Basswood per M	25 00 *a* 30 00

Cargo rates, 10 per cent off.

BRICKS.

	Cargo.	Afloat.
Pale, per M.	4 25 *a*	4 75
Up Rivers	7 25 *a*	7 50
Jersey	7 50 *a*	8 00
Haverstraw Bay	8 25 *a*	8 50
" " choice	8 62½ *a*	8 75
Favorite Brands	— — *a*	— —
Hollow Fire-Clay Brick	9 00 *a*	9 25

FRONTS.

Croton—Brown, per M.	11 00 *a* 12 00
" Dark	12 00 *a* 13 00
" Red	12 00 *a* 13 00
Philadelphia	30 00 *a* — —
Trenton	28 00 *a* 30 00
Baltimore	40 00 *a* — —
Clark's Glens Falls, White	30 00 *a* — —
" " Red Fronts	27 50 *a* — —
" " Molded Red and White	45 00 *a* 80 00

Yard prices 50 cents per M higher, or with delivery added $2 per M for hard and $3 per M for front brick. For delivery add $5 on Philadelphia, Trenton and Glens Falls, and $6 on Baltimore brick.

IRON—PER TON.

Duty.—Bar, 1 to 1½c. per lb.; Railroad, 70c. per 100 lbs.; Boiler and Plate, 1½c. per lb.; Sheet, Band, Hoop and Scroll, 1¼ to 1¾c. per lb.; Pig, $7 per ton; Polished Sheet, 3c. per lb.; Galvanized, 2½c. per lb.; Scrap Cast, $6 per ton; Scrap Wrought, $8 per ton—all less 10 per cent. No Bar Iron to pay a less duty than 35 per cent ad val.

Pig, Scotch—Coltness	26 50 *a* 27 00
" Glengarnock	25 00 *a* 25 50
" Eglinton	23 50 *a* 24 00
" American, No. 1	26 00 *a* 27 00
" American, No. 2	24 00 *a* 25 00
" American, forge	22 50 *a* 24 00

LEAD—PER 100 POUNDS.

German	— — *a* — —
English, common	— — *a* — —
Spanish	5 75 *a* — —
Foreign, refined	— — *a* — —
Bar	6 50 *a* — —
Sheet	7 50 *a* — —
Pipe	— — *a* — —
Domestic	4 63 *a* — —

TIN PLATES.—Duty, 1 1-10 cents per pound.

I. C. charcoal, 10x14, per box	6 50 *a* 6 75
I. C. coke, 10x14	5 75 *a* 6 25
I. X. charcoal, 10x14	8 25 *a* 8 50
I. C. charcoal, 14x20	6 50 *a* 6 75
I. X. charcoal, 14x20	8 25 *a* 8 50
I. C. coke, 14x20	5 75 *a* 6 25
I. C. coke, terne, 14x20	5 25 *a* 5 37
I. C. charcoal, terne, 14x20	5 37 *a* 6 00

NAILS—PER KEG.

10d to 60d, common, fence and sheathing	3 30 *a* 3 40
8d and 9d, common	3 65 *a* — —
6d and 7d, common	3 90 *a* — —
4d and 5d, common	4 15 *a* — —
3d and 4d, light	4 95 *a* — —
3d, fine	5 65 *a* — —
2d, fine	5 65 *a* — —
Cut spikes, all sizes	3 65 *a* — —
Clinch nails, 1½ to 1¾ inch	5 65 *a* — —
do. 2 to 2½ inch	5 40 *a* — —
do. 2¼ to 2¾ inch	5 15 *a* — —
do. 3 inch and longer	4 90 *a* — —

SOLDERS.

Half and half	— 16 *a* — —
Extra	— 15 *a* — 15¼
No. 1	— 13½ *a* — 13¾

ZINC.—Duty, sheet, per lb., 2½ cents.

Sheet, (cask) per lb	— 7¾ *a* 8 00
Sheet, (open)	— 8½ *a* — 9

STONE.—Cargo Rates Delivered in New York.

Amherst Sandstone, No. 1, buff, in rough, pr. cub. ft.	1 00 *a* — —
do do No. 2	— 85 *a* — 95
Bedford Stone	1 25 *a* — —
Berlin Freestone, in rough	— 75 *a* 1 00
Berea Freestone, in rough	— 75 *a* 1 00
Brown Stone, Portland, Conn	1 00 *a* 1 35
Bay of Fundy Wood Point Brown Stone	1 00 *a* — —
do Mary Point Brown Stone	1 00 *a* — —
do do Olive Stone	1 00 *a* — —
Brown Stone, Belleville, N. J	1 00 *a* 1 35
Granite, rough	— 60 *a* 1 25
Canaan Marble	1 25 *a* 1 50
Sutherland Falls Marble	1 25 *a* 1 75
Dorchester, N.B., Stone, rough, per foot	1 00 *a* — —

PAINTS.

Carmine, American, per lb	5 00 *a* 5 25
Chalk, per 100 lbs	— 35 *a* — —
China Clay, per ton	18 00 *a* 20 00
Chrome yellow, dry, per pound	— 12½ *a* — 28
Lead, red American, per pound	— 6¾ *a* — 7
Lead, white American, pure, in oil	— 7½ *a* — 8
Lead, white American, pure, dry	— 6¾ *a* — 7
Lead, white English, pure, in oil	— 9 *a* — 10
Litharge	— 6¾ *a* — 7
Ochre, Fr., dry, per 100 lbs	1 50 *a* — —
Ochre, ground, in oil, per lb	— 6 *a* — 15
Ochre, Vermont, per 100 lbs	— 75 *a* 1 00
Orange Mineral, English	— 9 *a* — 10
Paris White, American	— 1½ *a* — 1¾
Paris White, English, prime	— 2 *a* — 2¼
Paris Green	— 15 *a* — 28
Plumbago paint, patent, per lb	— — *a* — 25
Putty, per lb	— 2 *a* — 2½
Spanish Brown, dry, per lb	— 1⅛ *a* — 1¼
Spanish Brown, ground in oil, per lb	— 8 *a* — 9
Venetian red, per cwt	1 75 *a* 2 00
Vermilion, Chinese, per lb	— 85 *a* — 90
Vermilion, Trieste	— 70 *a* — 75
Vermilion, quicksilver, bags	— 50 *a* — 52½
Vermilion, American, common	— 15 *a* — 18
Whiting, per 100 lbs	— 60 *a* — 80
Zinc, white American, dry, No. 1	— 5 *a* — 7½
Zinc, white American, No. 1, in oil	— 8 *a* — 10
Zinc, white French, dry, (Red Seal,)	— 7 *a* — 8
Zinc, white French, in oil	— 10 *a* — 10½

VARNISHES—PER GALLON.

American Wearing Body	3 50 *a* 4 00
Coach Body	2 35 *a* 3 50
do do	1 80 *a* 2 00
Furniture	1 25 *a* 2 50
Black Asphaltum	1 00 *a* 1 50
Brown Japan	1 00 *a* 1 20
Liquid Paint Dryer	1 35 *a* 1 75
Harness, (black)	3 00 *a* 4 50
Shellac, Spirits	3 00 *a* 3 50

CEMENT—PER BARREL.

Portland (imported)	2 60 *a* 3 00
Portland (American)	2 25 *a* 2 50
Portland (Lafarge)	3 40 *a* 3 65
Lime of Teil	2 30 *a* 2 50
Lime of Teil, per ton	15 00 *a* 18 00
Roman	2 75 *a* 3 25
Keene's & Martin's, coarse	6 00 *a* 6 50
" fine	10 50 *a* — —
Rosendale	1 40 *a* — —

HAIR.

Cattle, per bushel of 7 lbs	— 16 *a* — —
Goat, " "	— 21 *a* — —

SLATE.

Purple roofing slate, per square	$5 00 *a* 6 25
Green slate	5 00 *a* 6 00
Red slate	9 00 *a* 10 00
Black slate, Pennsylvania, (at Jersey City)	3 50 *a* 4 50
Slate tiles, 1¼-inch, rubbed, per square foot	20 *a* — 25

PLASTER PARIS.

Duty.—20 per cent ad. val. on calcined; lump free.

Calcined, ordinary city, per bbl	1 30 *a* 1 40
Calcined, city casting	1 55 *a* 1 65
Calcined, city superfine	1 75 *a* 2 00

LIME—PER BARREL.

State, common	1 15 *a* — —
" finishing	1 40 *a* — —
Rockland, common, cargo rate	1 25 *a* — —
" finishing	1 40 *a* — —
Ground	1 10 *a* — —

Add 25 cents to above figures for yard rates.

FOREIGN WOODS.

MAHOGANY.

St. Domingo, crotches, ordinary to good, per ft	— 15 *a* — 28
St. Domingo, crotches, fine	— 20 *a* — 30
St. Domingo, logs, small	— 5 *a* — 8
St. Domingo, logs, large	— 8½ *a* — 14
Frontera, Mexican, large	— 9 *a* — 12½
Frontera, Mexican, small	— 6 *a* — 8
Other Mexican	— 6 *a* — 12½
Honduras	— 6 *a* — 12½

ROSEWOOD.

Rio Janeiro, ordinary to good, per lb	— 2½ *a* — 4½
Rio Janeiro, good to fine	— 5 *a* — 8
Bahia, ordinary to good	— 2½ *a* — 4½
Bahia, good to fine	— 5 *a* — 8
Honduras, per ton	10 00 *a* 20 00
Satin Wood, per foot	— 15 *a* — 75
Tulipwood, per lb	— 6 *a* — 7
Lignumvitæ, large, per ton	30 00 *a* 50 00
Lignumvitæ, other sizes	10 00 *a* 25 00

CEDAR.

Cuba, per superficial foot	— 7 *a* — 11½
Mexican, small	— 7 *a* — 8
Mexican, large	— 9 *a* — 11½
Florida	— 40 *a* — 75

RUBBER ROOFING.

Complete materials for new roof, per square	3 50 *a* — —

DEADENING AND ROOFING MATERIAL.

Mineral Wool for Roofs and Deadening, per lb.	— 1¼ *a* — 1½

LABOR.

Ordinary, per day	2 00 *a* 2 50
Masons, do	3 50 *a* 4 00
Plasterers, do	4 00 *a* — —
Carpenters, do	4 00 *a* — —
Plumbers, do	4 00 *a* 4 50
Painters, do	3 00 *a* 3 50
Stone-Cutters, do	3 00 *a* 3 50

DOORS, WINDOWS, AND BLINDS.

DOORS, RAISED PANELS, TWO SIDES.

2.0 x 6.0	1¾ inch.	$ 90 —
2.6 x 6.6	1¾	1 20 —
2.6 x 6.8	1¾	1 25 —
2.8 x 6.8	1¾	1 30 —

DOORS, MOLDED.

Size.	1¾ inches.	1½ inches.	1¾ inches.
2.0 x 6.0	$1 48	—	—
2.6 x 6.6	1 56	1 95	—
2.6 x 6.8	1 80	2 28	—
2.6 x 6.10	1 83	2 33	—
2.6 x 7.0	1 97	2 36	—
3.8 x 6.8	1 88	2 39	3 33
2.8 x 7.0	2 04	2 46	3 46
2.10 x 6.10	1 98	2 54	3 56
2.0 x 7.0	2 21	2 69	3 80

WINDOW FRAMES.

Up to 3.4 x 7.2, put together	2 30 *a* — —

DRAIN AND SEWER PIPE.

(Delivered on board at New York.)

Discount 50 to 60 per cent, according to quality and size of order.

PIPE, per running foot.

2 inches diameter,	$0 13	10 inches diameter,	$0 70
3 "	0 16	12 "	0 80
4 "	0 20	15 "	1 25
5 "	0 25	18 "	1 60
6 "	0 30	20 "	2 00
7 "	0 35	22 "	2 50
8 "	0 45	24 "	3 00
9 "	0 55		

REVIEW OF THE MARKETS.—In the lumber market during the past month supplies have been held steadily at full former rates, with an expression of belief prevailing, that the present year will witness a continuation of the prosperity of the year just closed. To some extent this expectation is based upon the theory of an open winter; but in any event, it is considered that buyers can gain no advantage until spring, and the summer offering of supplies again commences.

In the brick market scarcely anything of interest has transpired in common hards during the month. The tone has been firm, and a cheerful feeling has prevailed among the trade. Pale brick have been in quite as good demand as hards when quality has been anyway attractive, but complaints have been made that many of the offerings have run poor, and on these buyers have exacted comparatively easy terms. Fronts have sold in full proportion with other grades and have commanded a steady position on the general market.

In the lime market consumption has been good and increasing, with the position of sellers well fortified and the prices firm.

In the lath market very considerable amounts of stock are said to be still going into consumption or engaged for early delivery, thus reducing the quantity in second hands sooner than anticipated. On this basis receivers have manifested much confidence, and have fairly maintained the cost, but have rather refrained from an exhibition of buoyancy. Two or three good arrivals have recently taken place, and it is intimated that a further advance would bring more forward, unless the weather should prove very severe.

In the hardware market trade has only shown a moderate out-of-town demand, and this mainly on mail orders. From local sources however there has been a fair call, a great many dealers already commencing to fill out broken assortments in preparation for the new year's business, and as a whole the market has had a cheerful and promising tone.

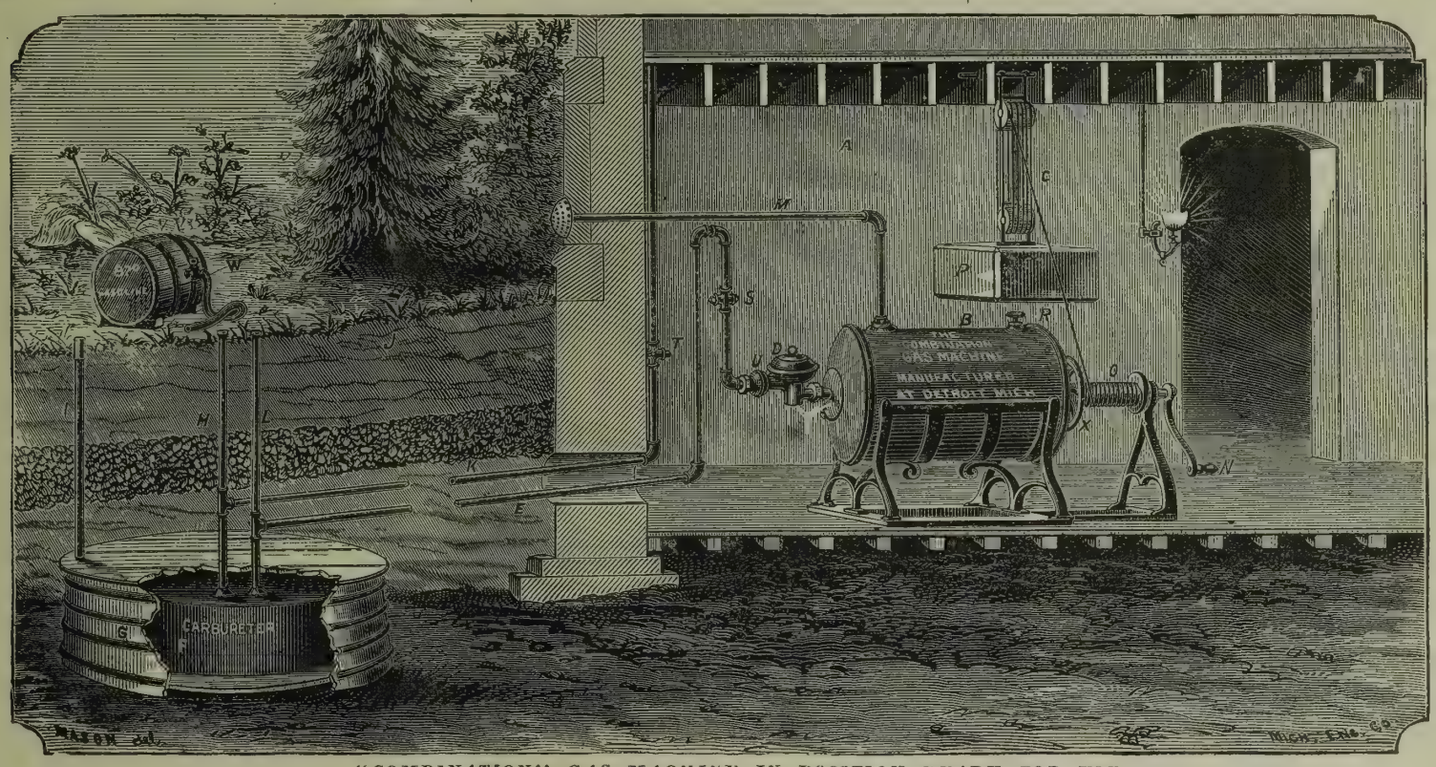
In the market for nails the demand has been moderate, and the general tone of trade not over firm.

In the metal markets the demand for American pig iron has been active, and there seemed to be more buyers than sellers. Some usually well-informed people in the trade say that all indications point to another "boom" and that everything in the shape of iron is bound to go much higher than the figures of to-day. It is difficult to offer an opinion regarding the course of the market during the spring activity, but judging from present appearances, the amount of iron produced falls short of the requirements of the country. Stocks of Scotch pig in second hands have been unusually light, and supplies have been greatly reduced during the month. Manufactured iron has been firm and very active. In lead the position remains the same as at our last writing, prices being well maintained. Pig tin has ruled firm. Tin plates have been steady and prices have advanced on most grades. The demand for zinc has continued good and prices remain unchanged.

Home Department.

The Combination Gas Machine.

Within the past ten years great improvements have been made in the construction of the special type of illuminating apparatus popularly known by the name of "gas machines." In general terms, these devices are designed to produce a gaseous illuminant, consisting commonly of air charged with the vapor of one of the volatile commercial products of petroleum. The material used for this purpose is uniformly that which is known as gasolene, and the vapor laden air is distributed and burned precisely like coal gas. The conveniences which such automatic gas generators afford to those living remote from cities, or in towns and villages where coal gas is not used, by placing the luxury of a brilliant illuminating gas at their disposal, made these machines very popular from the time of their first introduction, now over twenty years ago. It required, however, a number of years, and numerous improvements in important details, to entirely obviate certain serious objections that were urged against them. These related particularly to the disposition of the inflammable gasolene from which the gas was generated, and other less essential points affecting the safety of the apparatus under all the possible conditions of actual use.



"COMBINATION" GAS MACHINE IN POSITION READY FOR USE.

These objections at the present day have been very satisfactorily met in many forms of these machines now in use. The modern gas machine, where ordinary care and intelligence are exercised in its use, answers every reasonable requirement that could be demanded on the score of safety. Its convenience and economy in affording those living remote from cities, the luxury of an illuminating agent, in no respect inferior to coal gas, and at cost not exceeding, in most cases, one-half that of coal gas, are unquestionable; and for these reasons the so-called gas machines have been extensively introduced throughout the country, and are deservedly very popular.

A typical machine of this class, embodying in its design and construction all the improved features above alluded to, is that illustrated in the accompanying engraving, and which is known as the "Combination" gas machine, manufactured by the Combination Gas Machine Co., of Detroit, Mich.

The apparatus consists substantially of three parts: First, the air pump and its mechanical attachments, the object of which is to force the current of air over or through the volatile gasolene; second, the carburetor, in which the gasolene is stored in such a manner as to expose a large evaporating surface, so that the air forced through it by the pump shall readily charge itself to saturation with the hydro-carbon vapor; and third, the system of distributing pipes, through which the vapor laden air—now an illuminant—is conveyed to the burners. The air pump consists of a metallic chamber, strongly built and air-tight, containing a meter wheel working in water, and deriving its power from the gravitation of a heavy weight suspended from the ceiling. This pump is usually placed in the basement or cellar of the building to be lighted. A pipe conveys the air into the top of the pump chamber, whence it is conveyed by the action of the meter wheel from the side of the chamber through a suitable connecting pipe provided with a governor for regulating its pressure, and also a check valve, into the carburetting chamber. This portion of the machine is located at a distance of from 20 to 50 feet from the building. It consists of a flat cylindrical chamber, capable of containing a large supply of gasolene; and the liquid is so disposed therein as to afford a great length of evaporating surface over which the air forced by the pump must pass. For additional security, the carburetor is buried to a convenient depth in the earth, and surrounded likewise with a water chamber. From time to time (once, say, in three or four months), as may be necessary, the carburetor is filled with fresh material through a pipe leading from the buried chamber to the surface of the ground, with which communication is established through a flexible tube with the barrel of gasolene. By this system of construction the refilling of the carburetor is accomplished without risk or danger.

From the carburetor the vapor laden air, now suitable for illuminating purposes, is forced through the system of pipes communicating with the burners throughout the building to be lighted, in the usual manner as with coal gas. It will be understood from the foregoing description that the pump can only operate when one or more of the burners are in use; when these are closed, the back pressure on the meter wheel holds it immovable. The air pump is made amply large, so as to obviate the necessity of frequent winding up of the weight—once or twice a week is as often as this operation need be repeated. A governor is provided near the side of the air pump, whose office is to automatically regulate the pressure upon the burners; a check valve is also provided to prevent the back flow of gas from the carburetor to the pump in case of accident or breakage. A hand-wheel on the pump shaft for holding the pressure, enables the machine to be wound up while the lights are burning. The burial of the carburetor in the earth outside of the building, and surrounding it with a water tank, has two advantages. It obviates all probability of risk or danger in connection with the storage of a large amount of gasolene, and the refilling of the chamber; and it serves to keep the temperature of the liquid practically uniform at all times of the year. This feature is a point of considerable importance, as the quality of the gas furnished by such machines will vary very greatly when the gasolene is exposed to atmospheric changes. In summer the evaporation will be excessive, so that the air will be so heavily charged with vapor as to give a smoky flame, and in winter the evaporation, by reason of excessive cold, will be so greatly reduced, and the air consequently so poor in vapor, that the light will be poor and unsatisfactory. By this disposition of the carburetor, the liquid is maintained at nearly a uniform temperature, the amount of evaporation kept at about the same rate, and the quality of the gas is caused to vary very little, summer and winter.

The following references to the parts of the apparatus above described, may cause it to be better understood. Referring to the engraving, A is the basement of the house; B, air pump, for producing a supply of air and pressure; C, pulley and cords for raising the propelling weight; D, governor for regulating the pressure of the gas upon the burners; E, air pipe for conveying air from the pump to the carburetor; F, carburetor, containing gasolene, and in which the gas is generated; G, cistern filled with water, in which the carburetor is submerged; H L, filling pipes, through which the carburetors are filled with gasolene; I, filling pipe, for filling the cistern with water; K, service pipe for conveying gas from the carburetor to the main riser in the building to be lighted; M, air pipe for supplying pure air from outside of the building; P, propelling weight; R, opening for filling the pump with water; U, check valve to prevent the back flow of gas from the carburetor to the pump; W, barrel of gasolene, with filter cock and hose in position, showing how the gasolene may be taken from the barrel to the carburetor; X, hand-wheel for holding on the

pressure when winding with lights burning; Y, dry well.

The cost of gas produced by this class of machines will vary somewhat according to the price of gasolene. Estimating this at an average of 20 cents per gallon, and estimating that 5 gallons will produce 1,000 cubic feet of gas, the cost will be $1 per 1,000 cubic feet of gas equal to coal gas of good quality.

So far as we have been able to judge from the examination of this machine, it embodies in its design and construction every material feature that has come to be regarded as necessary or desirable in the construction of a gas machine.

The factory and office of the Combination Gas Machine Co. are located at Leib and Wight streets, Detroit, Mich., with a Chicago office at 236 Lake street. By addressing the company at either office, they will send one of their beautifully illustrated catalogues.

The Building Material Markets in 1881.

A retrospect of the markets for building material during the past year discloses many interesting particulars. A dominant feature of all the reports is the showing of an immense increase of business, a higher line of cost, in some cases very decided, and the purely legitimate character of the operations, positive consumption and shipping orders forming the only base of demand. Production has frequently been taxed to its utmost capacity, and the remarkable open weather to to the end of the year permitted the forwarding of work to such an extent as to leave comparatively small accumulations on hand for the early spring trade. Disasters have occurred to some extent among the trade, but nothing of a serious character, and so far as we able to learn, obligations have generally been fully and promptly met at maturity, a healthy financial situation thus adding an additional cheerful feature to the situation. It is, as yet, a little early to determine with any degree of accuracy as to the prospect for the coming season, but while dealers in some lines of material seem a little nervous over the absence of applications for estimates, a very much larger number express themselves in a confident and hopeful tone, especially as regards the spring trade. There has been some improvement during the year in the manner of furnishing the exports from this port, and our table of statistics will show a liberal outward movement.

The following shows in condensed form the export movement of the leading articles of building materials during the years named:

	Value			
	1878.	*1879.*	*1880.*	*1881.*
Bricks	$29,457	$9,731	$7,486	$8,663
Cement	16,399	23,849	23,455	28,701
Doors, Sash and Blinds	103,992	?	?	?
Fire Brick, Tiles, etc.	4,314	8,627	5,233	9,510
Lumber & Timber	1,202,297	1,225,114	1,478,627	1,666,786
Lath	1,656	2,576	1,300	1,368
Shingles	25,990	27,875	35,525	19,494
Paint	225,923	235,459	346,930	377,781
Plaster	23,073	14,902	15,321	24,419
Nails	163,706	163,735	241,535	277,213
Slate (roofing)	309,852	166,220	220,292	138,904
Stone	40,034	37,012	40,715	40,600
Roofing	6,101	5,120	3,254	8,189
Plumbing Material	....	....	....	7,842
Mantles	3,739	1,862	855	1,680
Houses	....	....	4,459	26,400
Bridges	.....	...	44,655	56,370
Miscellaneous	6,421	59,760	67,943	46,013
Total	$2,163,654	$1,981,842	$2,537,583	$2,739,283

The International Cotton Exhibition.

The Atlanta Exhibition closed December 31st, with appropriate ceremonies. The cost of the exposition was $250,000, of which $150,000 in round figures was put in buildings and improvements and the balance paid out for running expenses, printing, &c.; The receipts were from $220,000 to $250,000, of which $115,000 came from stock, $15,000 from privileges, $15,000 from entry fees, $90,000 for gate receipts, and $5,000 from miscellaneous sources. Add to those receipts whatever the buildings will bring, and we will have about the total receipts of the International Cotton Exposition. It is safe to say, that a quarter of a million people witnessed the exposition. The exposition did a vast amount of good in the direction of improved agriculture throughout the South. The amount of sales made of improved machinery was simply marvellous. The exhibitors all agree that they never saw a better selling exposition. There is scarcely a neighborhood in the Southern States into which an improved stump-puller, post-hole borer, plough, cotton planter, manure distributor, sulky plough, cultivator, or barrow has not gone, and which when introduced will induce the purchase of others. The benefits which will come from the sale of improved machinery may be accounted among the very best benefits to be derived from the exposition.

Learning a Trade.

Referring to the recent inauguration of a class in the science of plumbing, under the auspices of the Metropolitan Museum of Art, this city, a correspondent of the Philadelphia *Record* says: "If this will diminish the number of young men whose highest ambition seems to be to stand behind the counter and wear good clothes, it will be a public benefaction. There is a great deal of money in trades and very little in counter-jumping, and yet only one young man in a hundred is willing to blacken his hands with tools. It is not always the boy's fault, however. A gentleman of my acquaintance, who is a broker in Exchange Place, said to me recently: 'I ought to have been a machinist; I would have been rich by this time. When I was a boy I wanted to go into the Allaire Works, but my father was afraid it would soil my hands. He wanted me to be a gentleman. The result is that I have never liked my business, and never made more than a living at it. Had he let me go in as an apprentice in the machinist trade, I would have been building engines and coining money by this time, and my whole heart would have been in it.' The fathers of to-day in New York are the same. They would almost as soon bury their sons as make them apprentices. The result is a race of mediocre clerks and book-keepers, who part their hair in the middle, smoke cigarettes of paper, and find their intellectual level in the flash newspapers of the day."

Uniform Block List.

Some of the leading manufacturers of pulley blocks have adopted a revised and uniform price-list, as shown by the following:

"At a recent meeting held in Boston, the undersigned, representing three of the largest manufacturers of pulley blocks, agreed that on and after January 5th, 1882, they would adopt and use revised and uniform price-lists for tackle blocks. It is expected that other names will soon be added. All former lists and discounts from us are hereby null and void. Sheet lists are now ready, and book lists are in press and will be mailed to our customers as soon as ready.

"Signed: Bagnall & Loud, Boston; Detroit Block Works, Detroit; Penfield Block Co., Lockport, N. Y.
"*Dated: Lockport, N. Y., Dec.* 31, 1881."

Miscellaneous and Advertising.

Send ten cents to D. Van Nostrand, 23 Murray street, this city, for new catalogue of scientific books.

"How to Keep Boilers Clean," and other valuable information for steam users and engineers. Book of 64 pages. Published by Jas. F. Hotchkiss, 84 John street, New York. Mailed free to any address.

The steam pumps of the Valley Machine Co., of Easthampton, Mass., are, as ever, reliable, and are in extensive use for boiler-feeding and other purposes. The manufacturers are crowded with work, but with their extensive facilities find no difficulty in meeting all orders with promptness.

There is scarcely any class of machinery in which a greater amount of ingenuity has been expended than in the line of heavy wood-working machines, and no firm has kept pace better with the progress of the increased wants of wood-workers than Goodell & Waters, of Thirty-first and Chestnut streets, Philadelphia. The great variety of machinery produced by them comprises machines for planing mills, railroad shops, car-builders, cabinet, carriage, sash, door and blind makers.

The Hazard Manufacturing Co., of Wilkesbarre, Pa., having the largest and most perfect rope-making machinery in the world, are able to execute all orders very expeditiously. They make steel and iron wire ropes for mines, inclined planes, tramways, for transmitting power, suspension bridges, ship's rigging, etc. Ropes of any size are furnished by them, from a sash cord to ropes of 60 tons weight without a splice.

Many public and private buildings are being fitted with the heating apparatus of the H. B. Smith Co., of 8 Dey street, this city. The radiators of this company embody most perfect arrangements, and are made under Reed's and Gold's patents. This company also manufacture the Union steam and water heating apparatus and Mills' sectional safety boilers. Mr. A. Mercer is agent and engineer of the company in this city, while the manufactory is at Westfield, Mass.

Design for Suburban Residence.

The suburban residence illustrated on the opposite page, was recently erected for Mr. W. A. Smith, at Richfield Springs, N. Y., and gives evidence in its admirably arranged interior, and well broken exterior, of an intention well carried out to combine comfort and beauty without extravagance.

The large entrance hall is in itself suggestive of hospitality, while the bay-window in each of the three principal rooms gives to them an air of cheerfulness and comfort fully in keeping with this impression, enhanced by the open fire-place in each room, that in the sitting-room being a cosy affair tucked up in a corner.

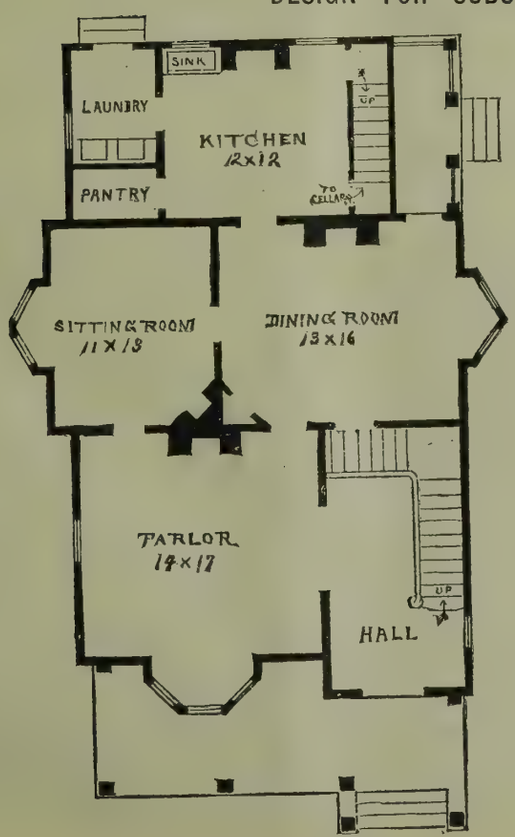
The space in the bedroom story appears to have been utilized in a most economical manner, and it would seem hard to make a better arrangement of the same number of bedrooms and closets, for each bedroom is provided with a closet, and an extra one—presumably for linen—is shown in the hall.

Good judgment is shown in breaking the lines of the exterior of the house, a few simple devices serving to give life to it all. A glance at the architect's specification shows that while the ultimate cost of the house has been kept in view, nothing has been done that would in any way affect its strength. The size of some of the timbers are here given; Beams in first story, 2×10 inches, set 16 inches to centers; in second and attic stories, 2×9 inches, 16 inches to centers, each tier having cross-bridging; the sills, 4×10 inches; the plate is two 3×4's spiked together; the studs are 2×4 inches, the window and door studs being 3×4 inches. The building is sheathed and covered with felt paper, and then clapboarded. The roof is shingled. The interior finish is pine, wood-filled and shellacked. Inside blinds are used, and are made of butternut, the slats being of ash. The cost is about $3,000.

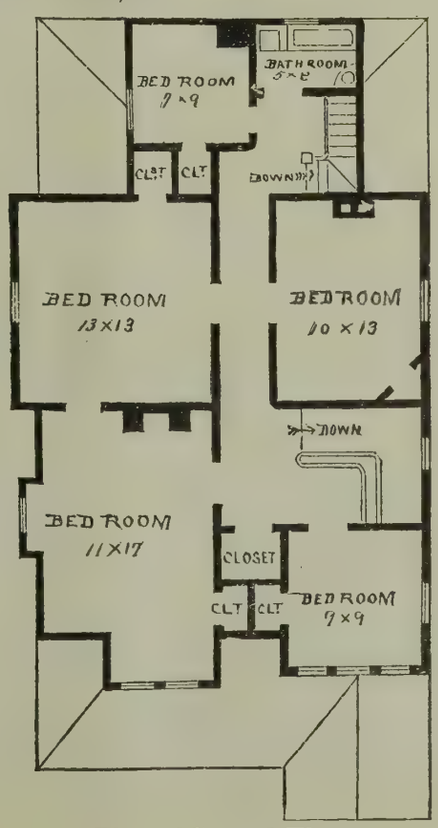
For any further information regarding this design, reference is made to the architects, Messrs. Smith & Howe, of 7 Warren street, New York

A NATURAL BRIDGE IN ALABAMA.—In Walker county, Ala., is a natural bridge said to rival that of Virginia. It is in the sandstone called millstone grit, which underlies the coal formation. It spans about 120 feet, and its hight is about 70 feet. A smaller bridge connects it with the bluff beyond. The lines of stratification of the sandstone give the structure the appearance of having been artificially built up with massive blocks. It is in the midst of a region of wild and romantic beauty, high escarpments of the same sandstone being seen standing out in the face of the hills around.

DESIGN FOR SUBURBAN RESIDENCE, COSTING $3,000.



Plan of First Floor.



Plan of Second Floor.

Internal Corrosion of Cast-Iron Pipes.

Mr. M. B. Jameison lately read before the Institution of Civil Engineers, a paper detailing the results of some interesting observations upon the internal corrosion of cast-iron water service pipes. His observations were confined to the city of Aberdeen, Scotland. The principal points of his paper are the following:

He finds that, generally speaking, the amount of internal corrosion in such pipes is proportional to the volume of water delivered through them, and the commotion existing in them from this cause; so that, for example, a main pipe may be found nearly filled with rust, while the branches are comparatively clean. He finds that corrosion produces two bad effects; first, a loss of water-carrying space, and second, a loss of pressure, in proof of which he submits several instructive tables. Table I. is given to prove the loss of water-carrying space in pipes in service for different lengths of time.

TABLE I.

Age of pipe. Years.	Internal diameter. Inches.	Rust per cubic yard. Cubic inches.	Space occup'd by rust. Per cent.
20	3	63.84	25.0
29	3	86.94	34.1
38	3	110.37	43.4
29	4	182.37	40.3
22	4	244.37	54.0
14	5	180.00	25.4
15	7	190.00	13.7
15	10	240.00	8.4
40	15	1,320.00	20.7

The rust has a marked effect on the discharge from a pipe; for instance, the water in a corroded pipe, registered by the gauge, a head of 77 and through a 22-inch outlet, the discharge was only 16 gallons per minute; while after cleaning the pipe registered a head of 82 feet and a discharge of 150 gallons per minute. Additional examples, though not showing so strong a difference, will indicate the effect of corrosion.

TABLE II.

Size of pipe. Inches.	Age of pipe. Years.	Corrosion per lineal yard. Cub. inches.	Head before cleaning. Feet.	Head after cleaning. Feet.	Discharge before cleaning. Gallons.	Discharge after cleaning. Gallons.
3	29	87	42	47	47	143
3	29	93	54	56	79	188
3	29	93	70	74	143	200
3	32	190	77	82	16	150
3	32	190	72	72	115	187
3	26	80	56	62	35	220
3	26	88	36	43	65	100
4	29	100	40	45	69	115
4	29	100	38	42	125	107

Papyrotile.

Papyrotile is the name given to the latest novelty designed for the decoration of interiors. It is neither paper nor tile, as its name would indicate, but is described as being a tough, pliant fabric, in substance like leather, though artificially composed of prepared materials, which result in a non-conductor of heat and sound.

These "tiles" can be readily and advantageously employed for wall or ceiling decoration, with the aid of glue or other cement. The material permits the use of the most varied and elaborate decorative designs, the decoration being applied with equal facility in one or more colors, to straight or curved lines, either flat or in high relief. The material has the advantage, also, of being readily cleaned with the use of the ordinary dust brush. The invention is an English one, and the building journals of that country speak of it in very favorable terms. The *Building and Engineering Times*, for example, says of it: "Papyrotile is at present a valuable addition to the media of plain or highly ornamental decoration, and should the manufacturers succeed in their intention of making it waterproof, its durability will be vastly increased, as also its more universal adoption as a material for mural decoration. Among the numerous rich specimens now on view, we are particularly pleased with a black dado, so like carved ebony as to deceive the eye in an eminent degree, serving as an effective ground to floral panels worked out in two shades of blue upon cream-white. A wall pattern in seventeenth century style occupies one side of the room where the samples are displayed, the subject being a foliated pattern in dark green with a frieze in black and gold of floral design, the dado being an imitation of ebony, paneled with gilt moldings, and relieved by a subordinate frieze in crimson on a gold ground. Some considerable variety of other papyrotiles are to be seen of exquisite designs, including foliated, floral, and geometrical patterns, suitably harmonizing with the prevalent revivals in art. Some of these are well suited for church work, and would look handsome in the form of a reredos. The rapidity with which this new decorative material may be applied was practically demonstrated by a workman who was engaged in making up a specimen, showing its adaptation to the adornment of a staircase. The particular design in this instance being a combined floral and foliated pattern in brown and black upon a neutral blue ground, relieved with a severe border in the same colors, the appearance of which would not fail to commend itself to a person of cultured taste. As a further incidental and perhaps necessary step in the process, the manufacturers are intending to utilize an impermeable glue."

REFINED COTTON-SEED OIL promises to have an important extension to its uses and consumption in the household, as a substitute for lard and butter for cooking purposes. For those materials it is said to be an excellent and superior substitute, and its cheapness recommends it very highly. As a large proportion of that which we export finds its way back to us again under the guise of "olive oil," and is enjoyed accordingly, it would not be amiss to give it a trial in the kitchen.

New Publications.

Sewer Gas and its Dangers; with an Exposition of Common Defects in House Drainage, and Practical Information Relating to their Remedy. By George Preston Brown. Chicago: Jansen, McClurg & Co. 1881. Price, $1.25.

This volume, while its author makes no pretense that it is either a scientific treatise on the subject of sewer gas, or a technical one on plumbing and house construction, nevertheless imparts a large amount of valuable information on all these subjects in practical and comprehensible terms. The great merit of the volume, however, is the clearness with which the author sets forth the alarming character and great prevalence of sewer gas poisoning. He has taken the opportunity of making a very extended personal investigation of the subject in Chicago, and very clearly proves the fact of the terrible effects of this insidious enemy to human life, by the record of a large number of cases that have come under his personal observation.

Numerous defects in house drainage are pointed out, and many illustrated intelligibly with the aid of full-page plates, of which there are twelve in the book. He heartily endorses the system of house drainage devised by Mr. C. W. Durham, of Chicago, and lately introduced into the new town of Pullman. This system involves, as one of its principal features, the effective ventilation of the main drain and connected pipes, through a suction pipe built inside the chimney, and extending some feet above its top. This suction pipe is connected with the main drain at the bottom. Experimental tests made by the author where this plan was employed, showed, he asserts, that in every instance there was a strong downward current in every water-closet when opened, rather than the puff of foul air into the room which commonly takes place.

No earthenware drains are used, and consequently there are no cemented joints, both of which are open to objection. The system is complete in itself—the soil pipes being made of wrought iron, and the horizontal drains usually put under ground, of cast iron. The former have screw, steam-fitting joints, and those of the latter are most securely calked with lead. The system is therefore strong and durable. That portion within the outside wall of the building is laid so that it may be always accessible. The system is unobstructed by traps, except one between the main drain pipe and the sewer, and this is made to hold so large a quantity of water, as to make it improbable that any pressure from the sewer will unseal it.

Mr. Brown presents the gravity of the dangers from imperfect and faulty house drainage in a most forcible and convincing manner, and he is very earnest in impressing this fact upon public attention, as preliminary to a discussion of the proper remedies. His book is written for the comprehension of ordinarily intelligent people, and is a very useful contribution to a very important subject.

Dangers to Health; a Pictorial Guide to Domestic Sanitary Defects. By T. Pridgin Teale, M.A., Surgeon to the General Infirmary at Leeds. Third edition. Philadelphia: Presley Blakiston.

It has seldom been our task to notice a book that has impressed us so favorably as this one. The method followed by the author is to represent pictorially every important fault to which domestic sanitary arrangements are liable, with the view of educating the public in the details of sanitary matters, so that, realizing their vital importance, knowing what ought to be avoided, and able to judge of the correctness and quality of work done, they may be able to avoid the manifold dangers that constantly menace the health and lives of the dwellers in houses made unwholesome by unsanitary arrangements and surroundings. The author quotes on the fly-leaf of his book, the following passage from Mrs. Jameson's "Legends of the Madonna": "A few scratches with a pen are better than whole pages of the most elaborate description;" and, acting on this very sensible advice, he has made his book precisely what he calls it in the title—a pictorial guide to domestic sanitary defects. There are seventy full-page plates, with descriptive text and explanations, and remarks opposite each, which represent in the most striking and convincing manner every form of defect and fault to which the sanitary arrangements of a dwelling house are liable, most of which have the merit of having been reproduced literally from cases that have actually been brought to the author's notice or have been personally observed by him. The plates are admirably made, and the text is clear and understandable. We do not know of a more valuable and useful guide to domestic sanitation than this one, and we give it our hearty commendation.

Underground Treasures; How and Where to Find Them. A Key for the Ready Determination of all the Useful Minerals within the United States. By James Orton, A.M., late Professor of Natural History in Vassar College, New York. A new edition with additions. Illustrated. Philadelphia: Henry Carey Baird & Co. 1881. Price, $1.50.

The above is a new and revised edition of a deservedly popular mineralogical manual, issued in attractive and convenient form. The book is eminently practical in the nature and arrangement of its contents, and is especially well adapted to the wants of that numerous class who have little or no acquaintance with the science of mineralogy, and who require a set of simple and practical instructions by which to distinguish and identify the useful and valuable ores and minerals when they are met with. To the prospector, the land owner, and in fact to any one to whom a practical familiarity with the useful minerals is desirable, and who has neither time nor opportunity to take up the subject of mineralogy exhaustively, Prof. Orton's little volume will be highly serviceable.

Palmblätter, von Karl Gerok. Mit Illustrationen. Philadelphia: Verlag von Ig. Kohler, 911 Arch Strasse. 1881.

The above is a new edition, forming an elegant duodecimo volume of the well-known religious poems of Karl Gerok, which in that branch of poetical literature take rank among the German classics. These poems have already run through over fifty editions, which fact alone is sufficient evidence of their popularity. Mr. Kohler, to gratify the popular demand, has issued the present edition in a form at once elegant, substantial and cheap.

Report upon United States Geographical Surveys West of the 100th Meridian. In charge of First Lieut. Geo. M. Wheeler, Corps of Engineers, U. S. A., etc. Vol. VII. Archæology.

The above is a valuable addition to the admirable series of reports of Lieut. Wheeler's surveys west of the 100th meridian, made by the authority of Congress and under the direction of the Chief of Engineers and the War Department. It is handsomely printed and abundantly illustrated with maps, plates and wood-cuts.

OTHER PUBLICATIONS RECEIVED.

Vick's Floral Guide for 1882. James Vick, Rochester, N. Y.

Second Geological Survey of Pennsylvania, C 6. The geology of Philadelphia county, and of the southern part of Montgomery and Bucks. By Charles E. Hall; with analysis of rocks by Dr. F. A. Genth and F. A. Genth, Jr. Harrisburg: State Print. 1881. From Hon. Geo. W. Hall, Philadelphia.

Second Geological Survey of Pennsylvania. Report of progress, G 5. The geology of Susquehanna county and Wayne county. By I. C. White. Harrisburg: State Print. 1881. From the same.

Second Geological Survey of Pennsylvania. Report of progress, M 3. Third report of progress in the laboratory of the survey at Harrisburg. By Andrew S. McCreath. Harrisburg: State Print. 1881. From the same.

Smull's Legislative Hand-Book. Rules and Decisions of the General Assembly of Pennsylvania, Legislative Directory, etc. By Wm. P. Smull. Harrisburg: State Print. 1881. From the same.

Report of the Committee of Science and Arts on Griscom's Electric Motor and Battery. (Reprinted from the Journal of the Franklin Institute, December, 1881). From the Electro-Dynamic Co., Philadelphia.

Seed Catalogue from Horace Sibley & Co., for 1882. Rochester, N. Y.; Chicago, Ill.

The West Side Association of New York. Transfer of Title to Real Estate. A lecture delivered before the Association May 7th, 1881, by Dwight H. Olmstead, President of the Association; with a synopsis of the New Zealand Land Transfer Act. Printed by order of the Association.

Correspondence.

We have received the appended communications relating to answers given in our department of "Notes and Queries." In one, it will be observed, the writer makes certain objections to the statements given in our reply; and in the other the writer supplements the information we gave with an additional and interesting fact. We are always pleased to receive communications of this character, and take this occasion to repeat our invitation to all readers who have, or believe they have, more accurate or complete information than that contained in any of our answers, to send them in, with the assurance that they will always be welcomed.—*Ed. M. & B.*

RULE FOR THICKNESS OF FLANGES.

To the Editor of the Manufacturer and Builder:

Allow me to differ with you in regard to your answer to my queries about the "thickness of flanges for cast-iron pipes," on page 240 of your October number for 1881).

All flanges that have come under my observation were thicker than the metal in the body or pipe, with a few exceptional cases, and these were so ordered. Flanges used by the Philadelphia water and gas works, and the New York, Brooklyn and Boston water works, are made from one-quarter to one-half thicker than the metal in the body—that is to say, if the metal in the body were 1 inch thick, the metal in the flanges would be from 1¼ to 1½ inches thick. And as a rule in "practice," I have noticed that the metal in flanges of other articles are made from one-eighth to one-fourth of an inch thicker than the metal in the body; and if the flanges are to be planed or faced, there should be added from three-16ths to one-fourth of an inch more to the casted flange, which would make the above flange 1¾ inches thick; this addition of metal allows the flange to be turned up to the ordered thickness.

It was the above observations that led me to ask you if there was a rule. Thanking you for your answers to my questions, I remain yours truly, H. C. Slaney.

Camden, N. J., December 3, 1881.

TO REMOVE CLINKER IN STOVES.

To the Editor of the Manufacturer and Builder:

In your issue of December, 1881, page 287, query 2922, a correspondent wants to know how to remove clinker from the fire-brick in his stove. Your answer is hardly satisfactory. You tell him how to "avoid" it in future; and even that he cannot do, as he cannot tell what coals will clinker or will not, in advance of test. I have taken the clinker off slick and clean several times, with nothing but common salt. Every day sprinkle a handful of salt around on top of the clinker next to the brick. Do this when the fire is a little low, and in a few days the clinker will let go, leaving the brick uninjured.

Yours truly, U. Cummings.

Buffalo, N. Y., December 21, 1881.

Notes and Queries.

This department is intended to furnish, for the benefit of all our readers, information on any subject of a scientific or technical character falling within the field of The Manufacturer and Builder. *Any of our readers possessing additional or more correct information than that which we give relating to the questions, are cordially invited to communicate it to us for publication. We also request that all questions or answers be written on separate pieces of paper, and addressed to the Editor.*

QUESTIONS.

(2928) Water Gas for Fuel and Lighting.—Will you be kind enough to give the address of parties engaged in the manufacture of water gas apparatus. I have watched its introduction and development with great interest, and am anxious to know if we can utilize it in lighting, heating and gaining power for printing office, ice-cream making, and if possible cooking for a restaurant and bakery. We have a building now in process of erection, and it might be desirable to work up with it. Gas and water pipes are being put in, but not heating pipes.—L. S. H., Middletown, N. Y.

(2929) Colors of Objects.—Have scientists ever succeeded in explaining why different bodies appear to have different colors?—why the rose should be red, the violet blue, etc.?—M. B. L., Alexandria, Va.

(2930) The Eye as an Optical Instrument.—Is not the human eye considered by men of science as a perfect optical instrument?—M. B. L., Alexandria, Va.

(2931) Remedy for Squeaky Shoes.—How can I prevent my shoes from squeaking? By informing me you will oblige.—A New Subscriber, Orange, N. J.

(2932) Decomposition of Steam.—What would be the increase of volume resulting from the decomposition of steam into its elements? or, if in a confined space, as in a steam boiler, what would be the increase of pressure?—A. W. R., New York City.

(2933) Cements.—Please inform me where I can get bisulphide of carbon cheapest in New York. What kind of guttapercha is best to use? What kind of isinglass is used? What is tannin, as mentioned in the different receipts in answer to query 2893 in your November number? Is there any way to make the carbon cement clear, like crystal?—M. J. D., East Boston, Mass.

(2934) Star-Like Rays from Luminous Objects.—Is the appearance of star-like rays emanating from a brilliant light or other luminous object, real or imaginary?—M. B. L., Alexandria, Va.

(2935) Cost of Dredging.—Are there any rules by which to estimate the cost of dredging? If so, where are they to be found?—J. G. H., Beaver Falls, Pa.

(2936) The Gunpowder Pile Driver.—Has the gunpowder pile driver been found to be successful in practical competition with the common steam pile driver? Is not the apparatus an English invention?—J. G. H., Beaver Falls, Pa.

(2937) History of Glycerine.—Please give me, for reference, some facts relating to the history and uses of glycerine, and oblige.—H. B., New York City.

(2938) Terra-Cotta.—Will you please inform me through your valuable journal, where I can get all kinds of terra-cotta molds, made of plaster of Paris, for vases, etc. Where can I buy a white enamel glaze, the same as that used to glaze bricks?—W. McB., Victoria, Tenn.

(2939) Paste Stove Blacking.—Please give a receipt for making paste stove blacking, and oblige a reader.—M. J. D., East Boston, Mass.

(2940) Power for a Wood-Working Shop.—I will be greatly obliged to you for advice as to the best steam power for a shop where wood-working machinery is to be used. I want to get power enough to run a planer, jig saw, slitting saw, edging saw, matching machine and lathe. I think I would like a portable engine with boiler combined—one that would do to put in the room with machinery. How many horse-power would it take to drive the machines mentioned?—E. H. C., East Rochester, N. H.

(2941) Coloring Cigar Wrappers.—Please inform me of the best way to color light and spotted cigar wrappers, so as to give the tobacco a rank taste.—E. B. H., New York City.

REPLIES.

(2928) Water Gas for Fuel and Lighting.—Replying to this inquirer, we can inform him of the addresses of two companies at present extensively engaged in the manufacture of water gas for lighting and fuel purposes. One is the American Gas Fuel and Light Company, at 139 Broadway (Room 2), New York, Walter E. Lawton, President, and the other is the National Gas Company, 430 Walnut street, Philadelphia, T. S. C. Lowe, President. The American Gas Fuel and Light Co. have erected works and laid down special pipes for fuel gas in the town of Yonkers, N. Y., where the gas is extensively used for heating, cooking and the like. We believe the gas is found entirely satisfactory for the purpose, both on the score of heating effect, cleanliness and convenience. In point of cheapness, it compares favorably with coal. At Pullman, Ill., a short distance from Chicago, a lately started and now flourishing and rapidly growing town, the same company have erected extensive works for supplying lighting and fuel gas in conjunction, which arrangement is reported to give universal satisfaction. The National Gas Co. employ the Lowe system of generating water gas, which, when it is to be used for lighting, is carburetted. For fuel this is unnecessary. In many cases where water gas is in use for lighting, it is likewise used for heating and cooking. To insure economy, however, the gas should not be carburetted when it is to serve for fuel, and should be distributed through a separate set of pipes, as is done at Yonkers. At present, we are informed, the National Gas Co. are engaged in introducing a Lowe fuel gas plant on an extensive scale in St. Louis, Mo.; another will shortly be in operation at Beaver Falls, Pa. The Lowe illuminating gas (water gas enriched with petroleum) is in use in Baltimore, Indianapolis, Lancaster, Harrisburg, Phœnixville, and more than twenty or thirty other towns and cities, and is a pronounced success. The use of gas fuel, however, is as yet comparatively new. There can be no question, however, that in the immediate future there will be an immense extension of its uses. The methods of manufacture of water gas have been so greatly perfected and cheapened, that there is now no valid objection to gaseous fuel on the score of cost, and in point of convenience and cleanliness its vast superiority over coal and other forms of solid fuel, must soon force its merits upon the notice of the public. We have held from the first that gaseous fuel was the domestic fuel of the future, and at a time when a well-informed portion of the technical and scientific press derided the notion as visionary. The state of public opinion on this subject to-day is very different from what it was only a few years ago, and the rapid progress of the innovation demonstrates that we, like all pioneers, were simply a few years in advance of the times with our ideas. Should our correspondent desire detailed information, he should communicate with the companies above named.

(2929) Colors of Objects.—Scientists have never succeeded in explaining why different substances should possess the properties that distinguish them, and such inquiries into the nature of bodies will doubtless always prove fruitless. We can no more tell why the rose should be red, than why the diamond should be hard, or platinum heavy. All that we know of the colors of bodies, is that every substance, simple and complex, organic and inorganic, has a peculiar property of its own, by virtue of which it selects certain rays from the light that falls upon it, which it transmits, and others which it absorbs, or reflects; and that according as this property varies, an object appears red, blue, green, etc. Why one body should have the property of reflecting or transmitting one color rather than another, is one of the problems that will probably never be solved. Modern science, however, has corrected some very gross errors of the ancients regarding the colors of bodies. We know now that the rose is red, not, as was formerly supposed, because it possessed redness in itself, but because the light which falls upon it contains some rays possessing the number of vibrations per second which give us the impression we call red, and which the rose reflects to the eye of the beholder. In other words, we know that the color comes from the light, not from the flower. To prove that such is the case, and that the rose is not always red, it is only necessary to remove it to a dark room and subject it to a source of light in which no red rays occur, when the rose is no longer red. If the rose is examined, for example, in a room lighted by a spirit lamp, or Bunsen burner, in the flame of which a fragment of common salt is suspended, all other light being carefully excluded, the flower will appear of a an ashy-gray or leaden hue. Other objects viewed by the same light are similarly affected. A bouquet of various colored flowers and leaves, under such circumstances, will appear to have a uniform ashy-gray color, only the yellow flowers will retain their natural color. A picture of the most gorgeous hues, viewed by such light, appears as a work in monochrome, and gives the effect of an India ink drawing. The most blooming complexion vanishes, and the countenance assumes a cadaverous aspect, the lips especially becoming repulsively livid. This experiment affords a convincing proof of the fallacy of the belief that the particular color which we are accustomed to associate with certain objects, is inherent in the object itself. The salted flame contains only rays of one kind—those which we associate with yellow. There are no red or blue or violet vibrations emitted, and as the objects on which the light falls cannot supply these, it follows that with this light no impressions corresponding to these colors can be produced on the eye. It is demonstrated, therefore, that colors come from the light which falls on bodies, and not from the bodies themselves. But why, when white light, composed of a combination of a number of rays of different vibrations, falls on objects, one should absorb certain of these rays and reflect others to the eye, and another should behave differently, is one of the unsolved mysteries. Referring to this selective power of different objects, we say they have this or that color. In this sense the rose is red. But why it should be red rather than green or yellow, or blue, we do not know, and probably never shall. All that we have thus far succeeded in finding out on this point, is that the redness is in the light that falls on the rose, and not in the rose itself.

(2930) The Eye as an Optical Instrument.—It has been the custom among many writers, especially among popular scientific writers, to speak of the eye as a perfect optical instrument. Even so generally accurate a writer as Dr. W. B. Carpenter, in his "Animal Physiology," (1859) states on this point: "The eye is much more remarkable for its perfection as an optical instrument than we might be led to suppose from the cursory view we have hitherto taken of its functions, for by the peculiarities of its construction, certain faults and defects are avoided, to which all ordinary optical instruments are liable." He names as among the imperfections which are completely corrected in the eye, spherical aberrations and chromatic aberrations, neither of which can be perfectly corrected in optical instruments. But on this question Dr. Carpenter is undoubtedly wrong. Recent investigations, most carefully conducted, have shown conclusively that the eye is not free from chromatic aberration; that it has defects analogous to spherical aberration; and that it has besides certain optical imperfections in its structure which are avoided in optical instruments. The greatest living authority on the science of optics, Prof. Helmholtz, whose great work on "Physiological Optics" is the most complete treatise on the subject that has ever appeared, is far from considering the eye to be a perfect optical instrument, for in this he remarks that should an optician send him an instrument having like optical defects, he would feel justified in sending it back. He admits, however, that the defects which may be traced in the eye, considered as an optical instrument, do not detract from its excellence considered as the organ of vision. Respecting the existence of optical defects in the eye, we may note that Sir Isaac Newton pointed out the chromatic aberration of the eye two centuries ago. Dr. Alembert, in 1767, showed that the lenses of the eye might have as great a dispersive power as glass, without the want of achromatism becoming noticeable. Dolland, the inventor of the achromatic lens, proved that the refractions that take place in the eye all tend to bring the violet rays towards the axis more than the red. Maskelyne, Wollaston, Fraunhofer, and others scarcely less distinguished for their scientific skill, have made actual measurements of the distances of the foci in the human eye for the different rays of the spectrum. In the face of these well-known facts, and of others we have not the space to name, the persistence with which the writers of popular science have adhered to the assertion that the eye is a perfect optical instrument, is only to be accounted for on the supposition that the error has been perpetuated because it accords

with a strong preconceived notion that the eye must necessarily be perfect, because it is so exquisitely adapted to human requirements as an organ of vision.

(2931) REMEDY FOR SQUEAKY SHOES.—Preventives are always better than remedies. If you would avoid having squeaky shoes, direct your shoemaker to put some powdered soapstone between the inner and outer soles when putting them together. The "squeak" is usually caused by the friction of one sole upon the other in the act of walking. Sometimes, however, it is caused by air getting in between the inner and outer sole, in which case the pressure and bending of the leather in walking forces the air out and produces a squeaking noise. If the soles of a shoe are composed of a single thickness of leather, or two or more pieces properly glued together, they will not squeak. A piece of muslin gummed to the sides of the inner and outer sole where they come together, will also prevent squeaking. In shoes already made, and in a faulty manner, so as to squeak, make two holes, about an inch and a half apart, through the outer sole, so as to insert the point of an oil can between the soles. A small quantity of sweet oil thus injected will generally cure the "squeak." If you do not succeed the first time, try again. A squeaky shoe always succumbs to the second dose of sweet oil. Three or four pegs or brads driven through the outer into the inner sole will oftentimes cure the trouble by binding them more closely together. But as trouble may arise from the pegs working through and injuring the feet, the remedies previously mentioned are preferable.

(2932) DECOMPOSITION OF STEAM.—It has been observed that in the formation of water by the union of hydrogen and oxygen, 2 parts by volume of hydrogen unite with 1 volume of oxygen. The resulting water vapor, however, does not occupy 3 volumes, but 2 volumes, which proves that condensation takes place in the combination. If the operation be reversed, and water vapor is decomposed into its elements, it is obvious from the above that 2 volumes of steam would yield 3 volumes of mixed hydrogen and oxygen gas; or, 1 volume of steam will afford 1½ volumes of the mixed water gases—that is, 1 cubic foot of steam would yield 1½ cubic feet of water gases, supposing the temperature and pressure to be the same after the decomposition as before it. If the decomposition of steam is supposed to take place in an enclosed vessel, where no change of volume can occur, the result of the decomposition will be to increase the pressure in the same proportion as the volume would have been increased—namely, one-half. In a steam boiler, for example, these conditions would exist, as the gases would be confined and not permitted to change their volume. The pressure therefore would be increased proportionally. An initial pressure of 20 pounds would become 30; an initial pressure of 30 pounds, 45, and so on.

(2933) CEMENTS.—Bisulphide of carbon can be purchased of any prominent dealer in drugs and chemicals. In New York it can be had cheapest of Eimer & Amend, 205, 207, 209 and 211 Third avenue. Crude gutta percha will answer our inquirer's purpose, as it is easy to pour off or strain the solution in bisulphide and free it from any accompanying foreign vegetable substances. Isinglass is simply a very pure glue, made generally from the sounds and other gelatinous membranes of fish. It is generally transparent. By using a first-class glue, the isinglass may be dispensed with in the first receipt. The word "tannin" is used to designate any liquor containing tannic acid. Infusion of oak bark, nut-galls, or sumac will answer the purpose. It would be difficult to obtain the cement quite clear, without too much thinning. One method recommended is to soften the gutta-percha in chloroform (or bisulphide) until it forms a thick paste. This paste is then to be transferred to very hot water, and kneaded with the fingers or otherwise. After considerable kneading and manipulation, the gutta-percha loses much of its color; and if this process is repeated several times, it becomes nearly colorless, having only a pale straw tint. A chloroform (or bisulphide) solution may then be made of any strength.

(2934) STAR-LIKE RAYS FROM LUMINOUS OBJECTS.—The appearance of a circle of streamers or rays emanating from a brilliantly luminous object, is purely subjective. To satisfy oneself on this point it is only necessary for one to conceal the luminous object from direct view by interposing some small opaque object as a screen between the bright object—say the light of a street lamp—and the eye, when the rays immediately disappear. This simple experiment proves that the rays do not emanate from the luminous object, but have their origin in the eye; for if they had any existence outside of the eye, they would still be seen. A second proof that the phenomenon originates in the eye and not in the object, is afforded by the fact that if, while attentively observing the rays, the head is inclined, the rays follow the movement of the eyes, so that when the head is resting on the shoulder, the ray which first appeared vertical, becomes horizontal. The explanation given of this phenomenon, and which appears to be very satisfactory, is that it is due to the fibrous structure of the crystalline lens of the eye. These fibers are possessed of somewhat different refractive powers from that of the intermediate substance. These fibers bend towards the axis of the lens, forming a figure something like a star with six permanent rays. When the light from a brilliantly luminous object enters the eye, and particularly at night, it develops this peculiar construction. This really constitutes another defect in the eye as an optical instrument, which we might have alluded to in the answer to the query on that subject given elsewhere.

(2935) COST OF DREDGING.—There are no rules by which the cost of this class of work can be estimated, save by the roughest approximation, as everything depends upon the nature and conditions of the work, and these may vary greatly. The same conservative authority we have referred to in our answer to the question respecting pile drivers, gives the following points as to the cost of dredging, which show how extremely variable it may be: Dredging is generally done by skilled contractors who own the requisite machines, scows, lighters, etc., and who make it a specialty. It is necessary to specify whether the dredged material is to be measured in place before it is loosened, or after being deposited in the scow, because it occupies more bulk after being dredged. It was found in the extensive dredgings for deepening the river St. Lawrence through Lake St. Peter, that on an average a cubic yard of tolerably stiff mud in place makes 1.4 yards in the scow; or, 1 yard in the scow, .715 in place. It is important to know if the removal of boulders, sunken trees, etc., is to constitute an extra or not. These often require blasting and sawing under water. The cost per cubic yard for dredging varies much with the depth of water; the quantity and character of the material; the distance to which it must be removed; whether it can be at once discharged from the machine by means of projecting side shoots or slides, or must be discharged into scows, to be removed a short distance by poling, or to a greater distance by steam tugs; whether it can be dropped or dumped into deep water by means of a flap or trap-doors in the bottom of the hoppers of the scows; or must be shoveled from the scows into shallow water (at say 4 to 8 cents per yard); or upon land (at say from 6 to 10 to 20 cents for the shoveling alone, or shoveling and wheeling, as the case may be); whether much time must be consumed in moving the machine forward frequently, as when the excavation is narrow and of but little depth, as in deepening a canal, etc.; whether many boulders and sunken trees are to be lifted; whether interruptions may occur from waves in storms; whether fuel can readily be obtained, etc. These considerations may make the cost per cubic yard in one case from two to four times as great as in another. The actual cost of deepening a ship canal through Lake St. Peter, to 18 feet from its original depth of 11 feet, for several miles through moderately stiff mud, was 14 cents per cubic yard in place, or 10 cents in the scows, including removing the material in steam tugs to a distance of about half a mile, and dropping it into deep water. This includes repairs of plant of all kinds, but no profit. It was a favorable case. When the buckets work in deep water, they do not become so well filled as when the water is shallow. Hence one reason why deep dredging costs more per yard, in addition to the necessity of raising the material through a greater hight. From these considerations, our inquirer will see the difficulty of establishing a rule for estimating the cost of work when the conditions are so extremely variable. We would suggest that he consult Trautwine's "Engineer's Pocket-Book," in which he will find much valuable practical information on the subject of his inquiry, in addition to what has been here presented.

(2936) THE GUNPOWDER PILE DRIVER.—So far as we are informed, the gunpowder pile driver is a successful and meritorious machine. It is more rapid and effective in performing its work than the common steam driver; and where the work to be done is extensive and difficult, we incline to the opinion that it would considerably surpass the ordinary steam machine in economy. Trautwine, in his "Engineer's Pocket-Book," refers to the gunpowder pile driver as a very meritorious invention. He explains that the hammer is worked by small cartridges of powder, placed one by one in a receptacle on top of the pile, and exploded by the hammer itself. It can readily make 30 to 40 blows of 5 to 10 ft. per minute; and since the hammer does not come into actual contact with the piles, it does not injure their heads at all, thus dispensing with the necessity of strengthening the heads with iron bands to prevent their battering and splitting, which is necessary with the common machine. When only a slight blow is required, a smaller cartridge is used. This machine, however, does not assist in raising the pile and placing it in position, as is done by the ordinary steam pile drivers; the latter, however, average only from three to six blows per minute. In respect to the question of comparative economy, the following additional details, given on the authority of Trautwine, will be useful in forming a correct opinion: The cost of a floating steam pile driver in Philadelphia; scow, 24 by 50 feet, draft 18 inches, with one engine for driving, and one (to save time) for getting another pile ready; with a one-ton hammer, is about $6,000; and $500 more will add a circular saw, etc., for sawing off piles at any required depth; requires engine man, cook, and four or five aids; will burn about half a ton of coal per day; driving 20 feet into gravel, and sawing off; will average from 15 to 20 piles per day of 10 hours; in mud, about twice as many; on land, about half as many as in water. A gunpowder driver, scow, etc., costs about $1,500 more, but will do about twice as much work as a steam driver. To drive a pile 20 feet into mud averages about ¼ of a pound of powder; with gravel, four times as much. The gunpowder pile driver is an American invention, having been invented and patented by Mr. Thomas Shaw, the well-known mechanical engineer of Philadelphia.

(2937) HISTORY OF GLYCERINE.—Glycerine was first discovered by Scheele, the Swedish chemist, while engaged in preparing lead plaster. It is the basic portion of the fats and oils, the same consisting chemically of various fatty acids combined with glycerine. It has only been used industrially on a large scale within the past twenty or twenty-five years, since the improved processes of decomposing fats in the manufacture of soaps and candles have come into general use. In the preparation of stearic acid for candle-making, the glycerine is set free and remains dissolved in the water, from which it may be obtained in a tolerably pure state and fit for most of its technical uses by concentration. Where the fats have been saponified with lime, a portion of the latter, which also goes into solution, must be precipitated either by sulphuric or oxalic acid, and the resulting liquor containing glycerine is then evaporated to the consistency of syrup. When the decomposition of the fats is effected by means of superheated steam or water, the glycerine is obtained in a comparatively pure state, and requires only to be concentrated. The soap boilers' mother liquor is also an important source of crude glycerine. This liquor is concentrated by evaporation, by which much of the saline matter is precipitated and removed from time to time; and when sufficiently concentrated, the glycerine is distilled by means of superheated steam carried into the still. The distillate is then concentrated in a vacuum pan. Glycerine is valuable in the industries by reason of its oily character; from the fact that when concentrated it remains fluid even below the temperature at which mercury freezes; the fact of its great stability; its non-volatility; its obstinate retention of moisture; its pleasant, sweetish taste; its solvent power for many substances; and lastly, because of its cheapness. It is used for keeping clay moist for modeling purposes, by reason of its avidity for moisture; for preventing mustard from drying up; for keeping snuff damp; for preserving fruit; for sweetening liquors; and for preserving and imparting a pleasant taste to beer, wine and malt extracts. It is used also as a lubricating material for some kinds of machinery, more especially for the works of watches and chronometers (for which it must be very pure), because it does not decompose or gum, and does not attack metals like copper, brass, etc. It is used in the preparation of copying inks, and of many kinds of cosmetics. It is an excellent solvent of the coal tar colors. It is often added to various materials to render them soft and pliable; for this purpose it is sometimes added to paper pulp, and as an ingredient of weavers' glue or dressing for the same purpose. It is a favorite application to the skin, preventing the chapping of the hands and face in cold weather. It renders leather highly pliable, and is used as a dressing for this reason. Being proof against freezing, it has come into extensive use as a substitute for water in filling gas meters. For this purpose it is well adapted also, because it does not evaporate in summer or attack the metal of the meter box. It has been successfully applied in hydraulic car brakes used upon railways, for which it has been used upon trains with the temperature considerably below 0° Fah. It is used also for preserving anatomical preparations, and for rendering wooden casks impervious to petroleum and other oils. It is now extensively used in the manufacture of the powerful explosive known as nitro-glycerine, which is made by treating glycerine with a mixture of strong nitric and sulphuric acids. It is also useful as a cement when mixed into a paste in concentrated form with finely powdered litharge. This cement rapidly hardens, and is useful as a cover for the corks or bungs of vessels containing such fluids as benzole, essential oils, etc. The consumption of glycerine amounts to many million pounds annually, a singular circumstance when it is remembered that only a few years ago it was a waste product and considered worthless.

(2938) TERRA-COTTA.—Our inquirer will doubtless be able to obtain what he desires by addressing either of the following named manufacturers of terra-cotta wares, namely, Clark Colored Brick and Terra-Cotta Company, Glen Falls, N. Y.; Akron Sewer Pipe Co., Akron, O.; Stewart & Co., 269 Pearl street, New York; or Moorehead Clay Works, 11 South 7th street, Philadelphia. For the white enamel of which he speaks, our correspondent should address himself to the Brick Enameling Co., 203 Walnut Place, Philadelphia, or to their works, Old York Road, above Hunting Park, Philadelphia.

(2939) PASTE STOVE BLACK.—We do not remember ever to have seen a paste stove blacking, nor can we imagine that such a paste could be as good as the black lead sticks commonly used for that purpose. The addition to black lead of any greasy substances to cause it to remain pasty, would, we think, injure its polishing qualities, and would also be apt to give off an offensive smell from the burning of the grease until it had been thoroughly driven off. The use of a watery paste of black lead, kept soft by the addition of a very little chloride of calcium or glycerine, might answer, but we fear it would be too difficult to polish. Our inquirer might try the last named suggestion.

(2940) POWER FOR A WOOD-WORKING SHOP.—Replying to this inquiry, we think that by application to E. P. Hampson & Co., 36 Cortlandt street, New York, manufacturers of the Phœnix horizontal stationary engine and boiler, he will most probably be suited. As to the amount of power required, this would be difficult to determine accurately without further details. He would want from 25 to 40 horse-power. The prices range from $1,300 for 25 horse-power to $1,700 for 40 horse-power.

(2941) COLORING CIGAR WRAPPERS.—The practice of coloring bad colored and spotted tobacco for cigars wrappers, is no doubt very general among cigar manufacturers. They are said to use generally dilute dye-wood extracts in ammoniacal solution. The practice is not specially hurtful, but, like every form of falsification, we look upon it as reprehensible.

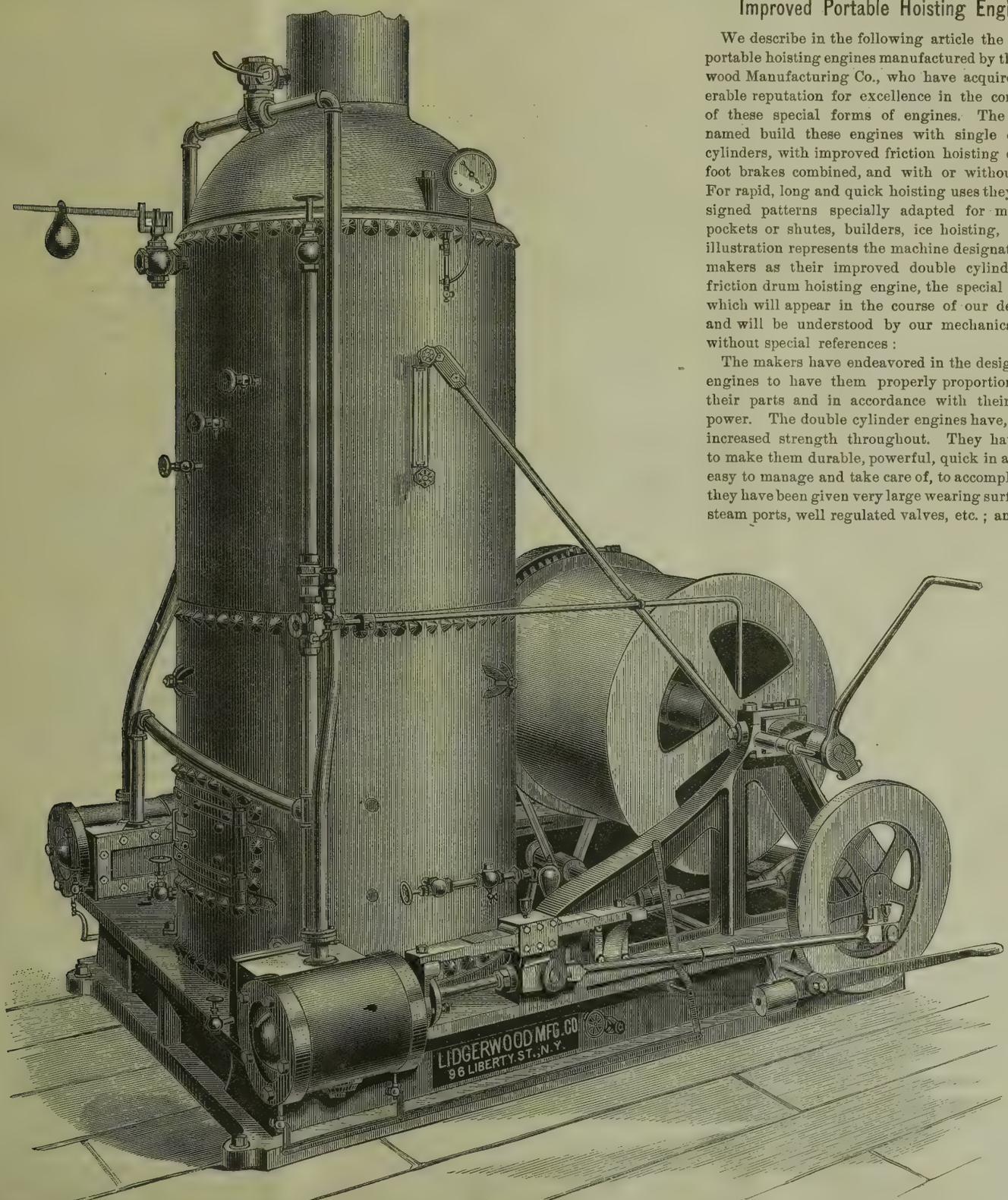
THE MANUFACTURER AND BUILDER.

Vol. XIV.—No. 2. FEBRUARY, 1882. FOURTEENTH YEAR.

Improved Portable Hoisting Engines.

We describe in the following article the improved portable hoisting engines manufactured by the Lidgerwood Manufacturing Co., who have acquired considerable reputation for excellence in the construction of these special forms of engines. The company named build these engines with single or double cylinders, with improved friction hoisting drum and foot brakes combined, and with or without boilers. For rapid, long and quick hoisting uses they have designed patterns specially adapted for mines, coal pockets or shutes, builders, ice hoisting, etc. Our illustration represents the machine designated by the makers as their improved double cylinder, single friction drum hoisting engine, the special details of which will appear in the course of our description, and will be understood by our mechanical readers without special references :

The makers have endeavored in the design of their engines to have them properly proportioned in all their parts and in accordance with their cylinder power. The double cylinder engines have, therefore, increased strength throughout. They have sought to make them durable, powerful, quick in action, and easy to manage and take care of, to accomplish which they have been given very large wearing surfaces, large steam ports, well regulated valves, etc. ; and to sup-



THE LIDGERWOOD IMPROVED DOUBLE CYLINDER, SINGLE FRICTION DRUM HOISTING ENGINE.

plement these excellencies of design, they have been combined with careful choice of material and superior workmanship.

The following description covers the most important details : The improved friction drum, a patented invention of these makers, is supplied to all their hoisting machines, and is claimed by them to be in many respects superior to other devices of the kind for hoisting uses — notably in being considerably quicker to handle and manage, and in saving the engine from sudden strains, which are unavoidable with the old style clutch engines. Engine and load start easily and without jarring, and the improved device is affirmed to be simple, easily kept in order, and, in point of durability, able to outwear the old style clutch arrangement at least four to one. The construction and action of these improved drums are as follows :

The drum is loose upon the shaft, having a bearing the whole length, one end having the ordinary flange while the other next to the spur wheel has a cone shaped flange upon the inside which is turned out taper or wedge shape to suit the wood which is composed of 12 segments and secured to the spur wheel : thus the friction is composed of wood and iron. These wood segments are made of the hardest kind of well seasoned hickory wood, each of which is secured to the spur wheel by a bolt and placed endwise of the grain to the wear and tear, the wood being turned off to suit corresponding shape of drum flange. In the operation of the drum it is moved off and on to the wood as the wood is stationary and fast to the wheel, the wheel being keyed to the shaft. The movement of the drum is accomplished by means of a handle attached to a screw with a pin, cross key and collar at the end of the drum shaft. A very small amount of pressure is required upon the handle to make the drum hold securely any load that the power of the cylinder can hoist, and the diameter and surface of the friction flange are made in proportion to the cylinder power for each and every size.

As to the reciprocating parts, the makers explain that the cross heads, slides, connecting rods, piston rods and valves, steam ports and valve motion are of locomotive design, perfectly balanced and equally as well made and calculated for durability, economy in use of steam, rapidity of action and severe duty. The piston rods, valve rods, cross head crank and all pins are made of cast steel. The connecting rods are made with the ordinary strap gibb and key ends, and the composition boxes are well proportioned and made. The cross heads and slides also have composition gibbs and extra large wearing surfaces ; all bearings are lined with the best anti-friction metals, have proper oiling facilities and provision to take up all wear and tear. All single engines are supplied with a band fly wheel which may be employed for any other uses for which power may be required, such as pumping, sawing, etc.

The cylinders are fitted with all necessary drainage cocks, Russia sheet iron jackets, lubricator, steam relief cock upon steam chest, etc., complete. Where boilers are provided, these are made extra large, the purpose of the makers being that they shall be well made and amply powerful for their duty. They are therefore made of the best brands of iron and tubes lawfully tested, stamped, etc ; each boiler being inspected and tested to 150 lbs. cold pressure. They are fitted with the following fixtures complete, viz : Improved spring safety valve, steam and water gauge gauge cocks, stop check blow and throttle valve, exhaust cock, smoke stack, grates, water and fire tight ash pan, fire tools, etc. The boiler feed pumps are of simple form, not apt to get out of order and are driven direct from the crank shaft by an eccentric power with long connection. They have composition valves, air chamber, etc., which are easily got at without tools or trouble, the object of the makers being to make them reliable and of sufficient capacity to supply the boilers easily.

The works of the Lidgerwood Manufacturing Co., are located at Elizabeth and Dwight streets, South Brooklyn, and the office and warerooms, at 96 Liberty street, this city.

The Manufacturer and Builder.

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Vol. XIV. No. 2. FOURTEENTH YEAR.

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Toronto News Co., Toronto, Ontario, Canada.
Toronto News Co., Clifton, Ontario, Canada.

The Destruction of our Offices.

The old "World" building, in which the offices of the MANUFACTURER AND BUILDER have been located for many years, was totally destroyed by fire on Tuesday, January 31st. The loss to the publisher of this journal is severe, and to some extent irremediable, as the fire consumed all the accumulated stock of back numbers, and many bound volumes, which, owing to the destruction of the electrotyped plates of some of the volumes, can only be partly replaced, save at great cost. The fire likewise put us to serious inconvenience in the total loss of pages and plates of the February issue, which was nearly finished at the time of the disaster. This will explain why the journal is later in reaching its readers this month than usual.

Immediately after the calamity, the publisher took steps to meet the unlooked for emergency. Commodious and convenient offices were secured at No. 21 Park Row, where the MANUFACTURER AND BUILDER will take up its permanent quarters hereafter, and work was vigorously started on the journal. In the future, the journal will reach its patrons at the usual time, and having gone safely through its "baptism of fire," we shall endeavor to make it more useful and interesting than ever.

We owe grateful thanks to many friends for their kind proffers of assistance in our time of need.

THE PUBLISHER.

The Potter Building Fire.

We are again called upon to direct public attention to the hazards to life and property by reason of the dangerous character of many buildings in this and other cities, and the extreme hazard to which human life is daily and unsuspiciously exposed.

A little time ago it was the Randolph mill fire, with its frightful loss of human life, that called forth our comments ; this time the scene is much nearer home, and the burning of the old "World Building" in New York, in which the MANUFACTURER AND BUILDER has had its offices since it has been in extence, affords us the melancholy theme of discourse. The fire in question, as most of our readers will already know, resulted in the total destruction of the building and its contents—no property worth speaking of having been saved—and in the loss of six lives. So rapid was the spread of the flames, that within a few minutes after the discovery of the fire the building seemed to be afire from basement to cornice, and the marvel is, considering this fact, and the utterly inadequate provisions made for the escape of the several hundred occupants of the burned building, that the loss of life was not vastly greater than it was. The building was one of the best known in lower New York, and was thronged with tenants. We give a brief description of the structure, and of the disaster and its lessons, in the following.

From the exterior, the burned building had the appearance of being a strong and substantial structure ; but its interior construction was such as to make it exceedingly dangerous to life in the case of fire, as the event has shown. There was but one dividing wall in the interior, and the partitions were of the flimsiest character and quite out of keeping in a building of such size.

The several floors above the first or ground floor were divided up into a great number of offices, by the erection of simple wooden partitions, and these again were in many places still further cut up for the convenience of tenants, so that the whole of the interior above the ground floor formed a labyrinth of halls and passages. Long wooden stairways communicated with the upper stories from both the Nassau street and Park Row entrances. At the first landing the stairways communicated with a lobby, above which was an open space clear to the roof, in the center of which there was a skylight 20 × 15 feet in dimensions, by which the interior space and the rooms on the

upper stories were lighted. Looking up from the lobby, one could see narrow corridors on the third and fourth stories extending nearly around the open space. Stairways connected these corridors and the halls branched from the landings on the various floors.

The building was comparatively an old one, having been built over twenty years ago, and its convenient location in the neighborhood of the Post-office, and in the very heart of the business quarter of the city, explain why, in spite of its want of many modern conveniences, it was crowded with tenants, of whom many were publishers of newspapers. It is quite within the limits of truth to place the number of persons employed in and occupying the building at 300, and save and except the wooden stairways before mentioned, there was absolutely no provision for the escape of those in the building in case of fire. From this brief account of the character of the building, our readers will be prepared for the statement that it was a tinder box, only awaiting the spark that should set it off, to be consumed ; and so the event proved. Indeed, so rapid was the progress of the flames, that within two minutes from the time that the alarm was given, the whole interior of the building, including the stairways, was a mass of flames, and all chance of escape by the only avenues provided for exit, was cut off to the unfortunates in the upper stories, who had not heard the alarm in time. The employees of the MANUFACTURER AND BUILDER made a very narrow escape. They were so fortunate as to receive early intimation that something was wrong, by the noise and confusion in the hall below, the doors of the office having been left open. Had they been closed, the number of victims might have been greater.

From the facts that subsequent investigation elicited, there is no doubt that the immediate cause of the fire was a defective flue. A new flue had lately been put in, and the fact that it was defective and dangerous, had been discovered by Mr. Beach, one of the tenants, the day previous to the calamity, and was by him communicated to Mr. Potter, the owner of the building. That such was the case is shown conclusively by the following testimony :

"Alfred E. Beach, one of the proprietors of the *Scientific American*, testified that on the afternoon before the fire he had found the wall hot over the new flue in the hall on the third floor, and smelled the odor of burning wood. He spoke to Mr. Potter about it. On the second, third, fourth, and fifth floors the wall opposite the new flue was found to be very hot. Mr. Potter showed the witness where a burned beam had been cut out of the chimney. Mr. Beach urged Mr. Potter to send for firemen to watch the place all night with hose ready to use. Mr. Potter insisted that there was no danger. Mr. Beach noticed the same smell next morning, and found the wood wainscot over the old flue near the Nassau street wall by the elevator very hot. On the floor below the wall over the flue was still hotter. He told Mr. Potter's clerk of the fact, and was answered that Mr. Potter had not arrived, but that men were at work, and that there was no danger. A strong smell of burning wood came up the elevator."

The evidence of Mr. Beach is corroborated by that of another witness, Mr. Cheever, who made the following statement:

"John D. Cheever, of the New York Belting and Packing Company, testified that on Saturday he had found the wall on the first floor, thirty feet from the Nassau street side so hot that he could not bear his hand on it. He notified the Home Insurance Company, and some one came on Monday to examine the wall. Smoke coming up the basement stairs on Tuesday morning was Mr. Cheever's first knowledge of the fire."

How far these facts affect the responsibility of Mr. Potter for the calamity and loss of life, has been determined by the coroner's jury, who, after a protracted and searching investigation, censure Mr. Potter "for neglecting to apply to the Department of Buildings for the proper permit for repairs or alterations, which would have caused an inspection of the premises by an officer of the department, and might have led to the discovery of the imperfections in question causing this disaster and the deplorable loss of life."

The Potter building is by no means the only "death trap" (as it has come to be called) in New York, for among the 95,000 buildings which the city can count, there are doubtless hundreds that are equally dangerous, and equally liable to cause the death of scores of human beings, as this one. If the naked truth respecting the dangerous character of many crowded buildings in this city was known, the public would be horrified at the risk to which thousands of people are exposed every day of their lives. That disasters like that we are here called on to discuss do not more frequently occur, is due to good luck and not precaution. It is only directly on the occurrence of some such calamity as this one, and the Randolph mill fire in Philadelphia, that the press thunders its denunciations and the public are aroused to a realization of ever-present danger to life and property.

It is earnestly to be hoped that the public indignation which the Potter building disaster has aroused, may cause the authorities to take measures to make the inspection of buildings far more effective than it now appears to be, and to enforce far more rigorously the laws respecting the introduction of fire escapes.

In striking and instructive contrast to the flimsy tinder box that was destroyed, stood the adjoining *Times* building, interposing the obstruction of its massive party wall to the further spread of the flames, and checking by its solidity and fire-proof construction what would doubtless otherwise have proved to be an extensive conflagration. No better illustration could be given of the utter folly of wasting money in building such a structure as the one destroyed, and hundreds like it here and elsewhere, and in time the destruction of property will teach capitalists, builders and insurance men the lesson, what the loss of life does not appear to be impressive enough to teach—that it pays best in the long run to put up a building right.

Silk Culture in the United States.

The fair of the Women's Silk Culture Association of the United States, now being held in Philadelphia, is probably the finest exhibition of its kind ever held in the country. Though not very extensive, it is thoroughly representative of the silk industry in all its stages for the eggs of the silk-worm, the cocoons, the reeled silk, and the numberless varieties of finished fabrics produced therefrom. What makes this exhibition of special interest to us, however, is the fact that, with few exceptions, everything upon exhibition is of domestic production, and the fair enables the interested observer to form something of an estimate of the extent and magnitude of the manufactures of silk in this country, with which most of our people are quite unfamiliar.

The special object of the Women's Silk Culture Association, however, is to foster and promote the raising of raw silk in the United States ; and though the association has been in existence less than two years, it has already accomplished wonders in this direction.

The ladies constituting the society have formed a bureau for the dissemination of information respecting the culture of silk. They have already distributed many hundreds of mulberry trees, and thousands of books of instruction on the art of rearing and caring for the silk worm. The interest which their work has attracted seems to be universal. Their correspondence extends over the entire country, and hundreds have been induced to engage in the work of raising silk. They have not stopped at this, but realizing the necessity of securing the proper coöperative of the cultivators of silk with the manufacturers, they have valorously attacked the problem of reeling the cocoons, and producing the fiber in merchantable shape, suitable for the use of the manufacturers.

In this important branch of their work they seemed to have met with pronounced success. To meet the objection that we could not in this country compete with the cheap labor of France and Italy, China and Japan, they have availed themselves of the services of an advisory board of gentlemen, and with the aid of the mechanical skill of certain of these members, they have succeeded in having designed and constructed a silk reel composed entirely of metal, which is far in advance of the crude hand reels in use in foreign countries. A skilled operator with this improved reel is now enabled to reel more than twice as much silk as formerly in the same time and with less labor. The reel referred to is the center of attraction at the fair room, and its operation is witnessed daily by interested crowds of visitors. To add to its interest, it is driven at high speed, and easily, by one of the Griscom electric motors, lately described in this journal.

The quality of the reeled silk under the society's auspices is pronounced unanimously by manufacturers to whom it has been submitted, to be in all respects satisfactory, and there is every reason now to anticipate that the impulse that the society's efforts have given to this interesting and valuable industry is so pronounced that their labors will ultimately achieve the permanent domestication of silk culture in our country.

Our manufacturers now require many millions of dollars' worth of silk annually, which, up to the present time, they have been obliged to import in the raw state from the countries named above ; and as the manufactures of silk are rapidly growing and extending, the value of these yearly importations is increasing every year. With the domestication of silk culture in this country, the immense sums now yearly sent abroad to purchase the raw product would be kept at home, and would be distributed throughout the country to the raisers of silk.

For the work it has already accomplished, and for what it is now doing, the Women's Silk Culture Association is worthy of the highest praise. We wish the society the fullest measure of success.

Tests of Fire-Proof Materials.

In connection with the late exhibition of the Massachusetts Charitable Mechanic Institute, the directors of that enterprise, with the assistance of a committee specially designated for the purpose, caused a series of practical experimental trials to be made of a variety of fire-proof building material that had been displayed at the fair.

The mode of carrying out these tests consisted in building a small structure, adapting the various materials to be tested to their appropriate places in it, then, after providing suitable draft openings, to set on fire, a mass of combustible material that had been collected and stored within it. The experiments were not conducted on a sufficiently large scale to give entirely satisfactory results ; but enough was learned by the trials to place beyond question the fact that a number of the fire-proof materials under test were excellently adapted for their intended uses, and the more important fact, that the construction of fire-proof buildings at a moderate increased cost above those built after ordinary methods, is quite feasible.

The results obtained by the fair committee were of so interesting a nature that the Boston Society of Architects were induced by them to take up the subject, with the purpose of continuing the experiments on a larger scale. We trust that the work of the society will be well and thoroughly done, and that it may be productive of useful results. We shall keep our readers advised of these trials as they are made.

The Worthington Pumping Machinery.

We show in the accompanying illustrations two forms of the Worthington pump, which have been very extensively introduced, and are highly esteemed. They embrace the essential and distinctive features of the Worthington system, which has been described very fully in previous issues of the MANUFACTURER AND BUILDER. For these details we refer our readers, therefore, to the numbers of our journal, and devote this article to a description of the special varieties of the apparatus illustrated in the cuts.

Fig. 1 represents a modification of the Worthington steam pump, arranged for using steam expansively, which cannot be done with the ordinary form. The arrangement is such that the steam, after having exerted its force through one stroke upon the smaller steam piston, expands upon the larger during the return stroke, and operates to drive the piston in the opposite direction. This arrangement effects practically the same object as is accomplished by the use of a cut-off on a crank engine, and has a notable advantage in giving a steady and uniform effect on the water. These compound pumps being very economical of fuel, saving 30 to 33 per cent, as compared with the usual form of steam pump, they are recommended wherever saving of fuel is an important consideration. As they require less steam for a given duty, likewise, their boilers may be somewhat reduced in size and cost, compared with those required by the high-pressure form. Wherever, therefore, economy of operation is sought for, this modification of the Worthington is to be preferred, and the result is said to fully justify the increased outlay on the pump itself. On the larger sizes the makers provide a condensing apparatus, where it is desired, which is operated either from the main engine or from an auxiliary one. With this addition, the highest economy is attained. The ordinary forms of the Worthington pumps can be fitted, if desired, with these compound cylinders, and in proportion to suit any service. When they are employed without the addition of condensing apparatus, the steam pressure should not be less than 50 pounds, in order to derive the proper advantage from them.

This modification of the Worthington pump is extensively applied to hydraulic elevator pumps, tank pumps, fire pumps, pressure pumps, mine pumps, and to engines designed for the water supply of small cities and towns.

Fig. 2, shown on the opposite page, represents a power pump of the same makers, which consists essentially of the water end of the Worthington pumping engine, connected with two cranks placed at right angles, so as to equalize the strains upon the shaft, and designed to be driven by gearing or a belt attached to the motive power.

In many establishments where water power is employed, and where it would be expensive to introduce a special boiler and steam pump for raising water, this adaptation of the Worthington pumping engine will be found convenient and economical.

The pumps are strongly secured to a heavy cast-iron bed plate, as will be seen by an inspection of the cut, Fig. 2, and the rods are provided with boxes and keys for taking up lost motion caused by wear of the parts. The valves are easily accessible for cleaning or replacing. The pump here represented, Fig. 2, has 14-inch plungers and 10½ inches stroke, but is made of any desired capacity, from 8¼-inch plungers and 10½ inches stroke up to 14-inch plungers with 18 inches stroke. They may be fitted with brass plungers and plunger rods when desired. The machines here illustrated and described are made by Henry R. Worthington, Hydraulic Works, offices, 239 Broadway, New York; 70 Kilby street Boston; and 707 Market street, St. Louis,

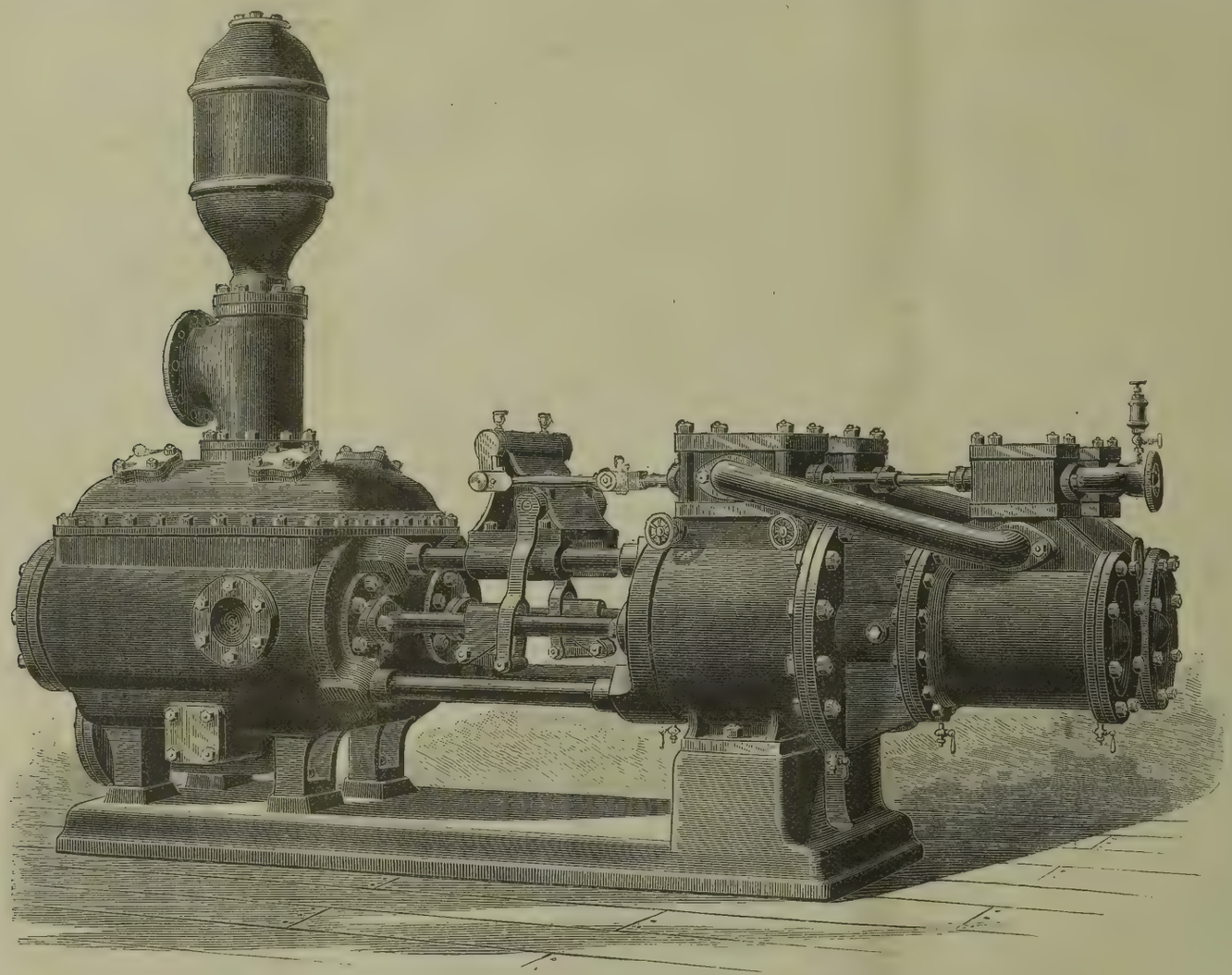


Fig. 1.—THE WORTHINGTON STEAM PUMP.

About Tools.

Imprisoned criminals have accomplished most astonishing feats in their efforts to escape. A large proportion of a certain unsavory class of literature consists of the recital of feats of this character. These men, it is true, have nothing else to divert their attention, and are impelled by a motive stronger than the desire of gain in the prosecution of their purpose. An instance of this kind which occurred very recently is a notable example of difficulty overcome. An imprisoned convict, without tools or material, contrived to manufacture a key with which he opened difficult locks and effected his escape in spite of the watchfulness of his guards. He scraped lead from a water pipe which ran through his cell, made a fire of splinters from his furniture, melted the lead in his spoon, and cast the key without attracting the attention of his watchers.

Men in similar condition have performed prodigies in the way of cutting iron bars, drilling through iron doors, breaking through heavy stone walls, constructing ladders, weapons, keys, files, saws, hammers and other tools. They have tunneled long distances beneath deep foundation walls and accomplished feats which would be regarded as difficult even with the aid of the best implements. It is said also that the finest and most perfect tools known to mechanical experts have been fabricated by criminals in order to effect their depredations upon society; coins have

been counterfeited which could only be detected in the melting pot, and bank notes which could not be detected at all. This unlawful work has been performed under the greatest difficulty, under fear of discovery and terrible punishment, at night, in remote places, under ground in localities where the ordinary sounds of work would be the means of detection and without a thousand hindrances in the way. The tool makers and tool users have furnished their quota to the ranks of evil doers, but in the main in spite of their surpassing ability these wrong doers have and are constantly defeated and made to suffer, because in all society they are largely in the minority.

A retrospect of the result of tool making and tool using shows very clearly that the destiny of nations has been decided oftener by their position and capacities in this respect than by any other factor in the case. It is under stating the matter to say that tools have revolutionized the world, for they have not only done this scores of times, but they have been a constantly acting force in bringing about the slower and deeper reaching changes which have passed over human society. To illustrate by an instance which comes within the personal knowledge of many readers of this paper. The cotton gin, by the use of which the production and use of cotton was rendered possible to an unlimited extent, placed the scepter of commercial and political power in the hands of the cotton raising section of the United States. People talk about "great moral ideas," "race peculiarities," "the diffusion of intelligence," and other influences which brought about the condition which existed just before the rebellion, but the simple fact is, that the cotton gin made cotton the most profitable crop that the world ever saw upon a large scale; consequently the cotton growing sections controlled the national power.

It was not the genius of statesmen nor the inherent ability of the people, but the ease, celerity and cheapness with which this implement separated the cotton seed from its fiber that decided the course of national history for a century. The order of things instituted was broken up by a process similar to that which began it. Another section of the country, having been driven to study the tool making problem, did so with such good success that there was greater profit in the industries which were connected with tools than with that of producing the raw material that they worked upon. In other words, there was more money in manufacturing cotton than in raising it. In the meantime tools and methods were discovered; the work of wood, iron, bars, chemicals and all other necessities of humanity had kept pace with the textile improvement. When the struggle for supremacy came the molders had the best of the business.

To-day the tide is turning the other way, so far as locality is concerned; the tool makers are spreading themselves over the producing regions, and in a few years there will be a total change of the geographical center of power. The prophetic gift is not necessary to enable one to see that what may be called the tool making interest will continue to control our national destiny, neither does it require great perspicuity to see that the benefits of great improvements in appliances are coming nearer to the individual. Patents are expiring year by year in the most important processes, monopolies which have heaped up money in few hands are tottering, prices of finished products are steadily and permanently falling and the cost of the necessaries of life is constantly decreasing.

Through the efforts of the genius inspired tool makers of the past, life will be made easy for generations to come.

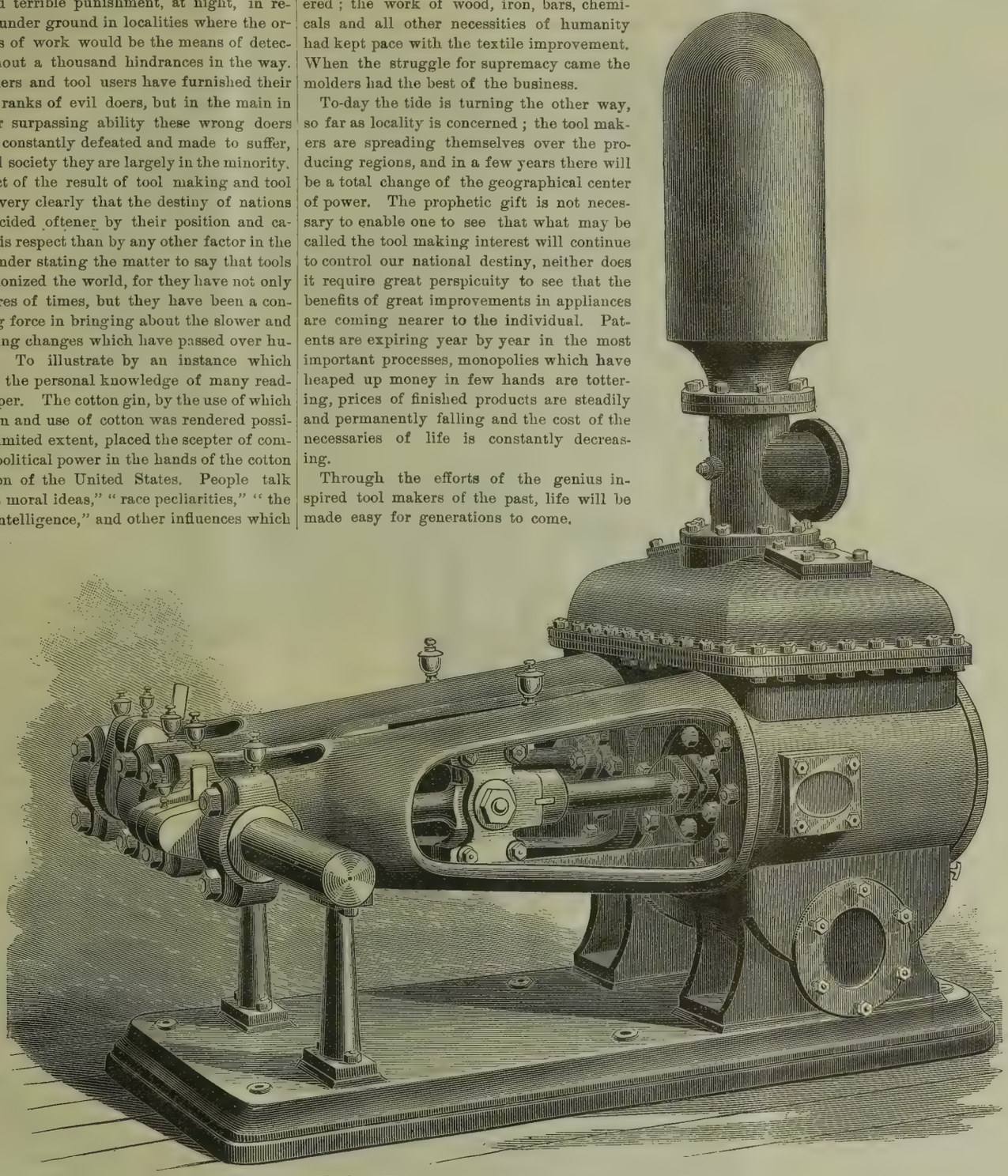


Fig 2.—THE WORTHINGTON POWER PUMP.

Terra-Cotta Lumber.

One of the most important of recent practical inventions is that of the manufacture of lumber from fire clay, patented by C. C. Gilman of Eldora, Iowa.

The process is fully described in his letters-patent, from which we extract the following:

The composition consists of kaolin clay, free from grit, one part; resinous sawdust, from one to three parts, as porosity may be required, water sufficient to thoroughly incorporate the above, by the aid of machinery, into a plastic mass.

Removed from the grinding tubs, where it had been ground, the spongy product is forced by plungers driven by steam through the iron or steel cylinders to express the superfluous moisture therefrom, and issues forth in the shape of long blocks or logs, of length form and size best fitted for handling, usually eight to twelve inches in thickness, and four to six feet in length. When sufficiently dry to render handling safe these logs are moved into kilns or clamps calculated for the purpose. After the steam and vapors are driven out by a slow, steadily increasing fire the temperature is rapidly raised to nearly a white heat, which not only consumes the sawdust, but brings the clay itself into the first stages of vitrification. On cooling, the logs are removed to the mill and sawed into planks, boards and dimension stuff, as lumber from wood is manufactured, and subsequently fashioned in the workshop into such forms and articles as demanded by purchasers. The material, being free from grit and tough in texture, can be cut, sawed, bored, planed and carved with edged tools, and before or after such treatment can, after slipping

and glazing, be submitted to a second firing, with fine results in ornamentation attained.

Kaolin is the upper stratum of fire or feldspathic clay beds, and owing to the absence of sand or free silica is unsuited to common pottery uses, as its warpage in drying and firing unfits it for molding purposes.

Mr. Gilman's invention overcomes this trouble, inasmuch as the material is reduced to form with edged tools subsequent to firing.

Terra-cotta lumber is indestructible by fire, gases or acids; is a poor conductor of heat, sound and electricity; and possesses a molecular attraction to an extent which allows of plastering without first lathing.

Its weight is one-half less than common building brick, and is erected with nails, instead of cement or mortar, virtually rendering fireproofing a work of masonry as heretofore.

One of the great needs of the time is a cheap fireproof material, and if the above invention possesses all the advantages claimed for it it will prove one of the greatest inventions of the nineteenth century, which is noted so much more than any preceding age for the number and usefulness of its inventions.

The Largest Clock in the World.

The great parliament house in London, England, usually called the Westminster clock, the largest clock in the world, was contracted for in the year of our Lord 1847, and started running in 1859, and started striking in July of the same year, although the construction was nearly completed in 1854 by the first Mr. Dent, a big name among the watch and clock makers of the present day. The architect was Sir Edmund Beckett Dennison, who, as a designer in horology, has ably proved himself on the top perch.

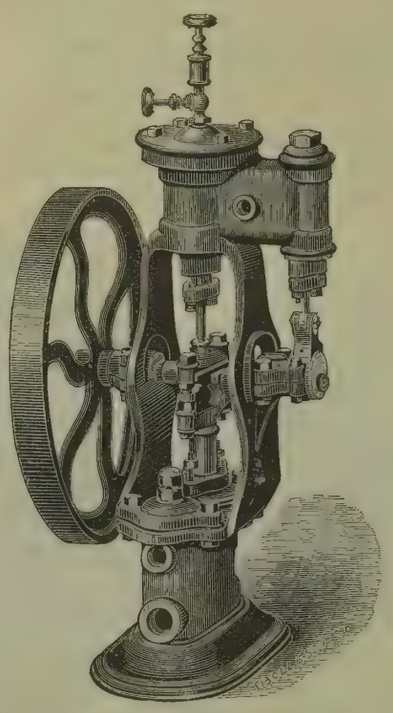
The clock in its general design is of that kind known as the platform kind, and its plates measure 16 feet over all; the ends are built into the wall, while the bracing resembles the trussing of our bridges. There are three trains of wheels: the train in center; hour strike train on the left; quarter train on the right. The main wheels are 40 inches in diameter, while the cam lifters for hammer tails are 38 inches diameter, There is only one cam lifter on main hour wheel, with 10 cams and 3½ inch faces of steel. In this connection the above strength is necessary on account of the hammer to be raised (420 pounds.) to strike the great 15-ton bell. The quarter chime hammers are much lighter, being in proportion to the bells to be struck by them. There are four, and they weigh from 3 tons 18 cwt. down to 1 ton 1 cwt. The diameter of hoop wheel is 30 inches, and the flies are in the usual proportion, but as the flies are driven with one pair of miter wheels to throw them on end and reduce friction, the flies proper resemble a large sized barn door, and the way they make the wind blow is awful.

The main wheel is 28 inches diameter, while the barrel is 16 inches, with a capacity for two feet of line. Great wheel has 180 teeth; center 120; third 120, with pinions of 15, 16 and 9. The escapement is the far-famed one—the gravity. This one is called the three-legged, and is formed of two wheels with three teeth each on the same arbor, with space between, and in this space come the lifting pallets, which are driven by the weight, and as soon as the pendulum swings against the partly lifted pallet it is released, thus allowing the pallet or arm to propel the pendulum on its opposite passage, where the same action takes place and a corresponding impulse is given. This escapement takes away all imperfections of trains, as the weight or pallet arm alone gives impulse. This clock beats two seconds; length of pendulum, 13.064 feet from suspension to line of oscillation; weight of ball, 685 pounds; length of suspension spring, 5 inches, 3 inches wide, and one-sixtieth of an inch thick; glass used in dials 2¼ tons, and with iron cost $26,670. Going part takes 20 minutes to wind; depth of well for weights, 174 feet; clock frame, 4 feet 7 inches wide; dials 22½ feet diameter; weight of minute hand, 2 cwt.; length, 14 feet; the pendulum rod is compensating, with an appliance for regulating. The cost of this clock, in addition to dials and hands, as above noted, was a little under $17,000 making the clock when finished cost the sum of $43,670.

The large bell is heard ten miles off and the small ones four to five. The clock is reported giving an error of only 90 seconds per annum; but the appliance for regulating by making it run faster or slower, debars us from forming an idea what it might be if left alone for one year.

The New Bucket Plunger Steam Pump for Feeding Boilers.

The steam pump herewith illustrated is of the bucket plunger variety of vertical crank and fly wheel pumps built by the Valley Machine Company, of Easthampton, Mass., and covered by the patents of



Bucket Plunger Steam Pump for Feeding Boilers.

William Wright and John Mayher. The Wright pump, which this company have been manufacturing since 1870, and of which several thousands are in use, is widely known as a most excellent machine. The manufacturers claim for this improved apparatus that it has all the essential qualities of the Wright pump (which they still continue to build), but by the very best possible distribution of metal without weakening the machine in any of its parts, the weight is brought down to a minimum, and by leaving off all outside finish, they are enabled to sell this pump at a very low figure.

For further information, apply to the manufacturers as above.

A New Discovery of the Cause of Boiler Explosions.

Mr. D. T. Lawson, of Wellsville, O., has discovered that water will burst into steam when the pressure is removed from its surface; and if the exploding water meets resistance, as in a closed boiler, the effect of the concussion will be greater than the regular steam pressure. Mr. Lawson's practical experiments upon a steam boiler made for that purpose, confirms his discovery to be correct. By suddenly removing the steam pressure, the boiler exploded, although it was strong enough to bear with safety double the removed regular steam pressure.

The same discovery was made some twenty years ago by Mr. John W. Nystrom, who published in his "Pocket-Book of Mechanics and Engineering" the principal causes of steam boiler explosions. In his "Treatise on Steam Engineering," Mr. Nystrom says: "The bursting of a steam boiler is a preliminary process to the explosion. If a vessel composed of any non-elastic material, is filled with water hermetically sealed in it, and if that water is frozen solid, the expansion of the ice will most likely burst the vessel, but there will be no explosion, because there is no explosive agency in it. A steam boiler full of cold water and tested with hydrostatic pressure until it bursts, will not explode; but if that cold water is heated to a temperature corresponding to the bursting pressure, there will be an explosion. When the steam pressure in any part of the boiler is suddenly removed by the bursting of the shell, the entire work of the heat stored in the steam and water is at the same time started with a velocity proportionate to the removed pressure. When the pressure is suddenly lowered below that due to the temperature of the water, the heat in it generates steam which raises the water bodily in the form of foam, striking the steam-side of the boiler, and the work is thus suddenly arrested. If the time of arresting the work is infinitely small, the force will be infinitely great, and thus the boiler explodes."

Mr. Nystrom's discovery, so far as regards the effect of suddenly removing the steam pressure is concerned, was undiscovered by the experiments upon the cause of boiler explosions made at Sandy Hook a few years ago, and now it appears that Mr. Lawson has rediscovered the same.

In the above named "Treatise on Steam Engineering," there are given eleven different causes of the bursting of boilers and consequent explosions, of which the seventh cause reads as follows: "It is a very bad practice to make boiler ends of cast iron, composed of a flat disk of from 2 to 3 inches thick, with a flange of from 1 to 2 inches in thickness, with cast rivet holes. The first shrinkage in the cooling of such a plate causes a great strain, which is increased by riveting the boiler to it. Any sudden change of temperature in such a plate, either by starting or putting out the fire, might crack the plate and cause explosion of the boiler."

It is evident that if cast iron ends are used in boilers, they should be made concave.

Paper Blankets.

To a Manchester firm belongs the credit of utilizing paper in this especially serviceable direction. At once cheap, cleanly, warm, and easily manipulated, paper seems expressly designed for the purpose to which it is now for the first time successfully applied. Of late years various attempts have been made to turn it to account in the manner described; but, owing to the crackling nature of the paper and the impossibility of securing free ventilation beneath paper coverings, the idea was abandoned again and again. In the production of the "Chartaline" blanket, as the new invention is called, these defects have been overcome in a satisfactory manner. Ventilation is obtained as full, free and perfect as takes place beneath an ordinary woolen blanket. The new bed covering is made of two sheets of paper, between which a layer of wadding, chemically prepared, is inserted in such a way that it cannot gather in lumps. The edges are strongly whipped; so that there is no possibility of a separation of the two pieces taking place. The paper is manufactured from the strongest fiber known, which, being softened by a special process, is free from the objectionable cracking and rustling sound that, as a rule, accompanies the manipulation of paper. It is true there is a slight crisp feeling when new, but this wears off and the cover-

let becomes soft and limp. At the same time the strength of the 'Chartaline' blanket is much greater than might be imagined, having regard to the character of the material from which it is manufactured. As far as looks go the new blanket has all the appearance of a woolen one, while the warmth it affords exceeds that of its predecessor when the size and weight of the two are brought into comparison. The trifling cost at which these serviceable articles may be obtained constitutes, however, when all is told, the chief advantage of the invention.

The Marvin Fire-Proof Safe.

The prime requisite of a safe for the storage of account books and valuables, is that it shall be fire-proof; next to this comes the requisite that it be so strong that thieves may not break in and steal. On the latter score we are here not so much interested as on the first, because of our experience at the burning of our old office at 37 Park Row.

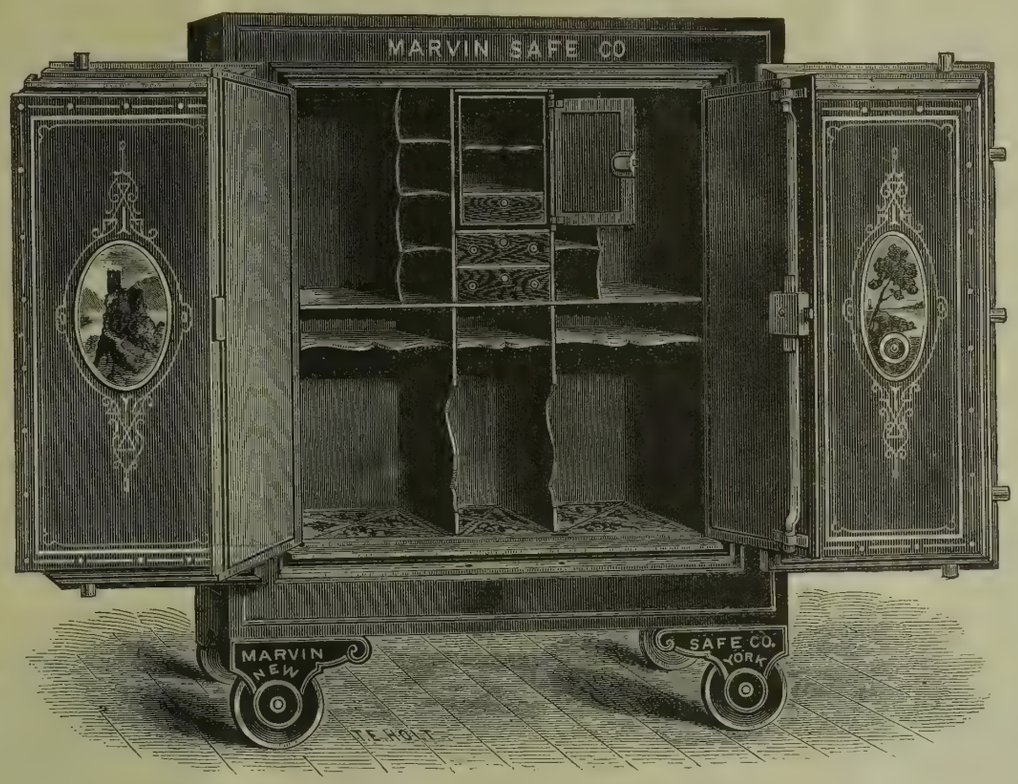


Fig. 1.—MARVIN'S FIRE-PROOF SAFE, No. 118.

In considering the possible methods of effectually protecting the contents of a strong iron receptacle like a safe against destruction in the event of a fire, in which it would be subjected to excessive heating, we are driven to the conclusion that the cheapest and best material to employ for the purpose is water. It has the highest specific heat of any known substance. In the conversion of water into steam an immense amount of heat is absorbed, and if we could succeed in practice in surrounding the body of a safe with a volume of water, so long as any of the latter remained the temperature of the interior could not be raised above 212° Fah. This fact has not escaped the attention of those engaged in the manufacture of fire-proof safes, and in some cases the makers have actually adopted the practice of making their fire-proof linings of water, contained in a series of metallic cases, so disposed as to fill out the space. This and similar plans would be quite satisfactory if it were possible in practice to avoid the breakage of the water receptacle and the flooding of the contents of the safe with water by the fall of the safe, which usually takes place. This objection operates in two ways; first, by the direct injury of the safe's contents by water, and second, by depriving the safe of its fire-proof lining, for so soon as the water has found its way through the covers of the safe by leakage, there is nothing to resist the charring and destruction of the contents of the safe.

Another objection to which this and similar linings are open, is the great difficulty which they present of keeping the interior of the safe free from dampness, and thus causing the moldering of its contents.

Dry non-conducting linings have, therefore, been almost universally preferred; and of these, the best material that could well be employed for the purpose is a mixture of alum and dry plaster of Paris. Such a mixture, in fact, accomplishes the purpose of providing an effective water lining for the safe, without any of its disadvantages. Alum is a salt containing an immense amount of water of crystallization. No less than 50 per cent of the weight of crystallized alum, in fact, is composed of water, held in solid form in combination. When it is subjected to a comparatively moderate heat, this water of crystallization is driven off in the form of water vapor or steam, so that alum really affords the safe maker an admirable vechicle, in compact, solid form, for providing an abundant supply of steam for keeping down the temperature of the interior of the receptacle in case it is at any time subjected to excessive heating. The alum, after being deprived of its water, is left as a dry pulverulent mass, which is known by the name of burnt alum.

The Marvin Safe Company, one of the best known firms employed in this branch of manufacture, were fortunate enough about ten years ago, to recognize the special advantages of alum for the requirements of safe makers, and patented the use of the mixture of alum with dry plaster, spoken of at the outset of this article. Plaster of Paris is itself a good non-conductor of heat, and acts as the carrier and distributor of the alum, preventing its too rapid fusion and the dissipation of the steam it yields. As employed in the safes manufactured by the Marvin Company, a mixture is made of dry ground plaster of Paris with coarsely broken fragments of alum, and this is filled into spaces provided between the inner and outer casing of the safe for the reception of the non-conducting material.

The efficiency of this lining has again and again been demonstrated. At the late fire which destroyed the old World Building, in which this journal had its offices, the majority of the safes owned by the numerous tenants of the burned structure were of the Marvin make, and, as we have been informed, they all went through the ordeal to which they were subjected in a highly satisfactory and creditable manner, in striking contrast with one of another maker, the contents of which were destroyed. The safe of the MANUFACTURER AND BUILDER was of the Marvin make, and it affords us much satisfaction to state that on opening it after its resurrection from the débris, our books and papers were found preserved in good condition.

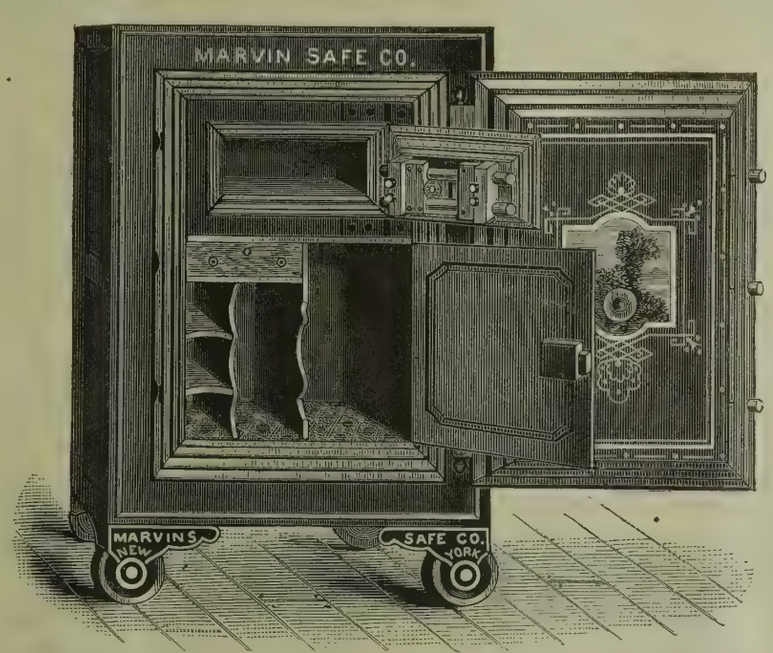


Fig 2.—MARVIN'S FIRE AND BURGLAR PROOF SAFE, No. 408.

Our illustrations represent two of the many styles of safes manufactured by the Marvin company. Fig. 1 is a folding-door safe, designated in the catalogue of the makers as No. 118. It has the following dimensions: Inside, 40 inches high, 36 wide and 14½ deep; outside, 54 inches high, 50 wide and 28½ deep; outside hight, including wheels, 62¼ inches; approximate weight, 3,500 pounds. It is made of heavy refined plate iron and angle iron frame, with the Marvin four-stepped or flanged door pattern, giving a greater depth of fire-proofing than is usual with safes of other makes. It has an entire inside iron lining, and is fitted with round bolts and the Yale combination lock of 1,000,000 changes. The inside doors are of plate iron, secured by powder-proof key-lock and round bolts.

The safe shown in Fig. 2 has the following dimen-

sions: Inside, 30 inches high, 20 wide and 14½ deep; outside, 44 inches high, 34 wide and 28½ deep; outside hight, including wheels, 52½ inches; approximate weight, 2,915 pounds. The material and construction of the exterior case is substantially the same as that previously described. In interior arrangement it differs in having a "banker's chest" of improved burglar-proof construction.

In all the safes of these makers the wooden partitions, wherever possible, are made movable, so that they may be changed at will; and those styles that are not provided with inside doors, are furnished with a "cut-off" or book-case protector, in the form of a wooden lining to the inside of the door, provided with an air space, which adds materially to the safety of its contents should the safe fall on its face in case of fire.

The Marvin safes are all provided with the best "Yale" combination bank locks on the outer doors, and small flat-key locks on inside doors. The iron plates of the safes are secured to the angle-iron frame on the interior of the safe by means of angle fish plates at regular intervals, forming a strong method of connection.

Wherever it is the intention of the owner of a fire-proof safe to entrust money or other valuables to his safe, it is important to provide the safe with some extra provision against robbery. In the Marvin safe the "banker's chest" which they provide affords ample protection. These chests are made of any desired size and thickness, and can be placed in any part of the interior of the safe. In the following we give a description of the construction of this burglar-proof work: It is made with solid wrought angle-iron frames, welded at all corners, with alternating plates of wrought iron and five-ply welded steel and iron combined, or with an interlining of consecutive plates of welded steel and iron, making it impracticable for the burglar to drill the iron and then break away the steel. Every plate is confined to its place by heavy steel and iron screws, with heads pointing inward, and no two screws are allowed to come in a line with each other, all plates being held together by heavy steel-headed conical bolts, with nuts on the inside, over which the end of the bolt is riveted, thus preventing burglars effecting an entrance by drilling or driving the conical bolts. To prevent burglars from forcing an entrance through the walls, by drilling a single layer of metal at a time and introducing powder to blow it off, all the interstices between plates are filled with a cement that hardens with age, so that the whole wall becomes as solid as a cast body. All corners are lapped with heavy, angle five-ply welded steel and iron as shown. The conical bolts and steel plates are tempered drill-proof, and tested by drill under heavy pressure before leaving the factory.

In addition to the admirable fire-proof qualities of the alum and dry plaster lining above referred to, we may mention finally the advantage it has over most other filling in use, in the quality of keeping the interior of the safe always dry, owing to the absorbent character of the plaster.

The address of the firm manufacturing these safes, is the Marvin Safe Co., 265 Broadway, New York.

Building Intelligence.

Architects, Builders and Contractors are invited to send us items of interest for this department. It is our object to notice only the more important operations in building, our space being too limited for the publication of minor matters, which, besides, possess only local interest. We wish to publish only such intelligence as is of general interest.

New York City Building Items.

An apartment house, to cover a lot 135 by 250 feet, is to be built this spring, from the designs of S. D. Hatch.

The New York Horticultural Society have selected a piece of ground on Fourth avenue, on which to erect a building to be called the New York Institute of Horticulture. They think the building will be ready in the fall for the next exhibition.

An extensive store building will be erected at 384 and 386 Broadway, extending through to Courtland alley; but neither the plans nor the architect are decided upon.

J. M. Slade is preparing plans for a six-story iron front store, to be erected by E. N. Tailer, on Greene street, between Grand and Broome streets. It will be 25 by 100 feet, and cost $30,000.

Miss Ellen Yeaman proposes to erect a five-story flat house, 25 by 78 by 98 feet 9 inches, at 312 East Thirty-fifth street. The architect is Albert Wagner.

James Stroud has prepared plans for two six-story flat houses to be erected at 28 Laight and 7 Vestry streets. They will be 27 feet 3 inches by 66 feet each, the lot running through from street to street, a distance of 175 feet.

Samuel C. Fenwick proposes to erect a three-story high-stoop brown stone dwelling, 15 by 50 feet, on the south side of One Hundred and Twenty-sixth street, 285 feet east of Seventh avenue, from plans by John Brandt, at a cost of $8,500.

Jacob Cohen proposes to erect a row of five five story brick tenements on Walker street, commencing at the southeast corner of Baxter street. They will be of various dimensions, ranging from 15 by 35 feet to 28 by 40 feet. The architect is Julius Boekel.

A store, 50 by 100 feet, is to be built on the north side of Twenty-third street, between Sixth and Seventh avenues. The building will extend from Twenty-third to Twenty-fourth street, and will have a front on each street of brick, with stone and terra-cotta finish. The cost will be about $90,000. S. D. Hatch is the architect.

J. Morgan Slade is at work on plans for a large six-story iron front store building, to be erected on the southeast corner of Broadway and Bleecker street, by Charles W. Codling, trustee. It will be 25 by 200 feet, extending through to Crosby street, and have all the modern improvements, including a passenger elevator. The cost will be $100,000.

The house on the southeast corner of Eighty-fourth street and First avenue is to be altered into a flat, with a large extension, at a cost of about $3,500. The architect is John Brandt. The same architect is also at work on the plans for altering the building on the northwest corner of Hester and Ludlow streets into a store, 25 by 42 feet, with plate glass windows. The upper portion of the buildings is to be used for apartments. The cost will be $2,000.

Miscellaneous.

The Boston Rubber Company are to erect a factory at Melrose, Mass., with buildings 1,400 feet long.

A post office is to be built at Spring Lake, N. J., to cost $2,500, from designs of C. W. Romeyn, of this city.

T. A. Howell, of Brooklyn, N. Y., proposes to erect a residence at Greenport, L. I., at a cost of about $18,000.

A frame residence is to be built for Schuyler L. Parsons, at Islip, N. Y. James E. Ware, of this city, is the architect.

The Missouri Car and Foundry Co., of St. Louis, Mo., are building a brick addition to their foundry, at a cost of $3,000.

Geo. A. Freeman, Jr., of New York, has prepared designs for two cottages in the old colonial style, to be built for C. A. Cheever, at Wave Crest, L. I.

At Westhampton, L. I., a residence in the old Dutch farm-house style, is to be built for A. P. Whitehead, from designs of W. H. Wood, of Newark, New Jersey.

Miss Jesse Lindell has just finished a five-story stone front store at the corner of Sixth and St. Charles streets, St. Louis, Mo., at a cost of $20,000.

In Brooklyn, N. Y., the congregation of the Grace Methodist Episcopal Church, intend erecting a church and Sunday school, covering a lot 97 by 100 feet, at a cost of about $45,000, on the corner of St. John's Place and Seventh avenue. The seating capacity will be 600. Parfitt Bros. are the architects.

On the corner of Broad and Lombardy streets, Newark, N. J., a six-story brick apartment house, 60 by 100 feet, is being built for L. Dennis. W. H. Wood is the architect.

A cottage in the old Norman style is being built on the Hutton estate, at Orange, N. J., for the Countess de Moltke, to cost about $15,000. W. H. Wood, of Newark, is the architect.

An elevator is to be erected in East St. Louis, Mo., with a capacity of 900,000 bushels. The plans are already made and contracts let. The building will be 175 feet high.

During the present winter the St. Sauver Hotel, at Bar Harbor, Me., which was burned some time since, is being rebuilt on a larger scale than formerly. It is expected that it will be ready for guests the coming season.

William Howe is preparing plans for a frame church, in the Gothic style, to be erected by the Union Avenue Baptist Church, in Paterson, N. J., on Union avenue, beyond the Falls. It will have a seating capacity of about 250, and cost $7,000.

A hotel of brick and stone and frame, to cost at least $180,000, is to built at Pueblo, Cal., from designs by James R. Crompton, of Newark, N. J. One half is to be let on the first contract, and that is to be completed before the building of the other half is started.

The Boston Steam Blower Company has purchased a lot of land from the Hall estate at the corner of Business street and Glenwood avenue, Hyde Park, Mass., and proposes to build a large machine shop as soon as the frost is out of the ground. The building will be 200 feet in length and two stories in hight.

Horace G. Knapp is drawing plans for a row of six frame cottages, two and a half stories high, to be erected on Ocean Parkway, Coney Island, by Dr. J. G. Morey. The cottages will be 20 by 36 feet, with kitchen extensions, and will be approached by a balustrade terrace, containing flowers, vases, etc. The cost will be $10,000.

A syndicate of New York capitalists have secured an extensive beach front at the foot of South Carolina avenue, Atlantic City, N. J., and have nearly completed arrangements for erecting the most extensive iron pier on the Atlantic coast. They also contemplate, it is said, the erection of an extensive hotel, bazaars and pavilions.

Joseph Balsley, architect, of Seymour, Ind., prepared the plans and superintended the erection a $12,000 hotel at Seymour. Four business blocks, costing some $11,000, and five handsome residences, costing $18,000, have been prepared from designs by the same architect, for erection at the same place. Also a school-house costing $6,000.

G. F. Meacham, of Boston, is the architect of a house for G. E. Allen, at Newton, Mass. The foundation, measuring 45 by 62 feet, is completed, and the house will be two stories with pitch roof. The first story is to be finished in mahogany. H. F. Ross is the contractor. The cost will be about $25,000.

At Seabright, N. J., a cottage is to be built for Dr. Lucius D. Buckley. J. C. Cady & Co., of New York, are the architects. A hotel and store adjoining are also to be built at this watering place. They are to be constructed in the old English style, with shingle fronts and massive brick chimneys, at a cost of about $25,000. The designs are by H. Edward Ficken, of New York.

At Nashville, Tenn., a building 86 by 135 feet, is to be built on the corner of Cherry and Union streets, for Col. E. W. Cole. It is to be fire-proof, and will accommodate a safe deposit company and a bank; the rest of the building will be for office purposes. The materials to be used for exterior work will be brick with limestone finish. The cost will be about $100,000.

Amesbury's Improved Band Saw Filing and Setting Machines.

We illustrate and describe herewith two eminently useful and practical machines, designed respectively for the purpose of facilitating the operations of filing and setting band saws, both of which operations have hitherto been performed unsatisfactorily. These machines accomplish their intended purpose so simply and satisfactorily that their utility will be at once appreciated by our mechanical readers who are interested in the use and care of band saws.

We describe the band saw filing machine of Mr. Amesbury first. This machine is illustrated by Fig. 1. Its object is to enable a band saw to be filed in a more rapid and accurate manner than could be done by hand. Hand-filing, even when done by the most expert workman, is always more or less irregular, producing high and low teeth in the blade, and leaving it in a condition that it cannot do so much work as one properly filed, with all the cutting points in line. The machine about to be described accomplishes this object rapidly and satisfactorily. To file a band saw (which ordinarily contains from 500 to 1,800 teeth) by hand, will take an expert filer from 30 to 90 minutes; and where the saw is running constantly, will require to be re-filed or sharpened several times a day. A machine, therefore, that will perform the work rapidly and accurately, and at a reasonable cost for files, has been greatly needed by users of band saws. The machine illustrated by the accompanying engraving has been devised by Mr. Amesbury to meet this want. It is exceedingly simple in construction, and has been thoroughly tested in practice by the maker, with respect to its adaptability to satisfactorily meet all the requirements of filing band saws rapidly, accurately and cheaply, before offering it to the makers and users of band saws. In its present form the machine can be run either by hand or power, and any boy that can turn a crank can file a band saw in from five to ten minutes, more accurately than an expert filer could do it by hand in an hour. The machine is designed to set on an ordinary bench, as seen in the engraving, and the saw blade may either be suspended from a simple yoke above the machine, or may be left in place on the band sawing machine. The filing machine is provided with a feeding mechanism that can be adjusted to suit any size of teeth, and is so arranged that it will feed only the tooth that is to be filed.

The mechanical construction of the machine will be understood from the following: The file-head is composed of two sections, one stationary and the other movable in the direction of its axis. The stationary section carries the feeder and a very thin segmental file, which is intended to file only the face and throat of a tooth. The movable section carries a thick beveled file, suitable for the different grades of teeth, and rotates on a higher plane and files the back of the tooth which has previously been filed on its face by the thin file, and at the same time cleans off the burr on the point of the tooth. This file is adjustable up or down by a thumb-screw D, to suit the grade of teeth, or to give any desired pressure upon the back of the same. The object of this construction is to divide the labor of the files and relieve the blade and machine from the strain occasioned by filing all parts of a tooth at one time, and at the same time to get all possible wear out of the files.

The construction of the ordinary three-cornered file used for saws is well known; the corners being the most delicate part, are the first to wear away, and although the body of the file is still good, the corners being gone, is of no further use. The plan adopted in this machine is to provide a light, cheap file, cut only on its face and corner, for sharpening the face of the teeth and gumming out the throat, and to alternate with a thick beveled file which sharpens only the back of the tooth. Thus is secured the entire wear of the more expensive file, which will outwear two or three of the cheap corner files, and can be renewed at a low cost.

The head carrying the files runs in an oblong bearing which permits it to vibrate to and from the saw, to compensate for high teeth or any other irregularity, and is provided with a pressure spring in the thimble E, which can be adjusted to give any desired pressure against the teeth. It is also provided with a spring under the head, which gives it an upward pressure against the face of the tooth. Thus, it will be seen, that the high teeth, receiving the most pressure, will soon be filed to a level with the lower ones, and no trouble will be experienced in keeping them uniform. The saw is held in a clamping jaw with the back resting against the gauge F, which is readily adjusted to any width of saw by the screw C, and can be set at any angle. The clamping jaw is operated by a cam on the hub of the gear, and opens and closes as the machine is feeding or filing. This jaw acts like a vise upon the saw when the files are in contact with the teeth, and immediately releases it when in contact with the feeder.

From the foregoing description, and an inspection of the cut, our mechanical readers will readily comprehend the action of this machine. It is characterized by great simplicity; it is strongly constructed, and is affirmed to be very durable; it can be readily adjusted to its work. The files are made of the best mill steel, and they can be replaced at a cost corresponding to that of an ordinary saw file. The machines are made to take band saws from one-16th inch to 2 inches, and from the finest tooth to two teeth to the inch.

The band saw setting machine, designed by the same maker, is a machine equally useful and convenient in its way to the makers and users of band saws as the machine above described. It is shown in Fig. 2. It is characterized, like the filing machine, by eminent simplicity, and in practice will be found to embody all the good features of hand-work, with the advantage of executing its work with much greater uniformity and speed.

The following considerations will serve to make clear certain of the qualifications that a machine of this kind must possess. To set the teeth true and accurate on a band saw, the blade should be clamped firm and rigid in a vise. If the saw is simply held in position by passing through slots, which must be open enough to admit the easy passage of all the thickest parts, the blade will yield back and forth with the action of the dies against the teeth, and as the blade varies in thickness, so will the set vary in the teeth. Again, to produce an even set, the pressure on every tooth should be exactly the same. The action of the arm in moving a lever back and forth is spasmodic, and the force of the blow, or pressure, on the teeth varies as the arm is fresh or weary. A circular motion has been found to be the most desirable for this purpose, and when a heavy fly wheel is used, the momentum produces even and uniform work at each end of the stroke.

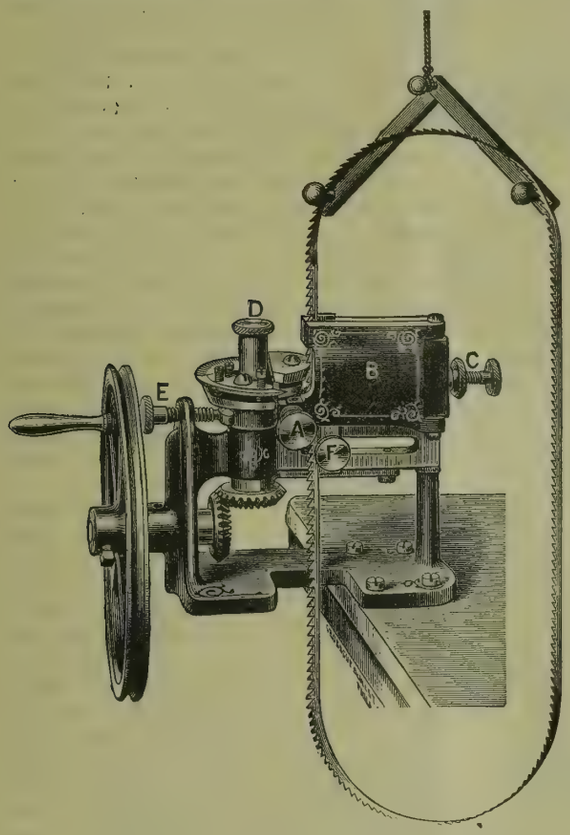


Fig. 1.—Band Saw Filing Machine.

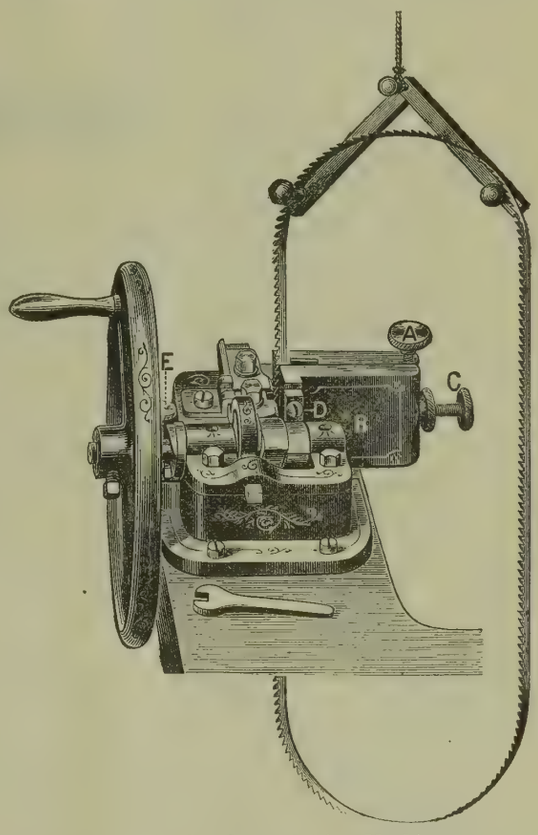


Fig. 2.—Band Saw Setting Machine.

Furthermore, a machine of this kind, to fully meet the requirements of practice, must be able to hold a narrow saw blade in a rigid position, and set the teeth without straining the blade.

The machine herewith illustrated and described answers these requirements, so far as we may judge from a careful examination of its construction and operation, very fully, and without unnecessary complication of parts. Its construction and action will appear from the following: It is arranged to work by an easy, uniform crank motion, and when the tooth to be set is fed into position, the blade is firmly locked between the steel jaws of a vise, and remains immovable while the tooth is set to any degree required. As the crank goes forward the blade is released, when the next tooth is fed up to the dies, the blade again locked in the vise, and this tooth set in the opposite direction. All these movements are automatic, and can be carried on at a speed of 300 teeth per minute. The feeder picks up only the tooth that is to be set, consequently each tooth is fed to its proper position regardless of its irregularity. No further expense is required outside of the machines, as the band saw is simply hung up over the machine on a wooden bracket and the lower part left pendant near the floor.

These two machines have been designed by Mr. G.

W. Amesbury, and are at present offered to users of band saws by Messrs. G. W. Amesbury & Co., of 3101 and 3103 Chestnut street, Philadelphia.

Explosion of a Horizontal Tubular Boiler.

The boiler here alluded to was of the horizontal tubular pattern, of ordinary proportions, and lacking a steam dome. The first rupture took place through a portion of the plate, which, upon its surface, appeared to have the strength due to a full line of metal of this thickness (¼ inch), but no doubt the line A B, Fig. 1, which is that of the initial break, was weaker than any other longitudinal line of similar length in this shell. This boiler was 54 inches in diameter and nearly 12 feet long, containing 71 tubes 3 inches in diameter, with a length equal to that of the shell. The plates were ¼ inch thick, double riveted at the longitudinal seams, as shown in the sketches, and the safety valve was loaded for 90 pounds pressure per squre inch, but by-standers affirmed that they had often seen the gauge register 100 pounds, or near it, and the "boiler a second-hand one at that," with considerable emphasis on the compound adjective, which means simply that it had changed owners or location since it left first hands. Its strength may have been impaired thereby if it was abused in moving, or subsequently in its use. The contingencies attending the manufacture of iron, and the shaping and fastening of it in the form required, and the abuses it may undergo in the hands of ignorant or unskilled attendants, render it highly desirable that something more than an apparent margin of strength should exist in every steam boiler. If the calculation of resisting power is based on a sample of metal of a high grade of tensile strength, there should be no doubt as to the uniformity of its structure throughout. If no inferior bar could possibly get into the pile; if there could be no imperfect welding of the pile; in short, if no dishonest or imperfect work could affect the result—in other words, if human imperfections could be eliminated from the problem of the uniformity of the metal, we might depend with confidence on the test of a single sample of the metal as a basis for the calculation of the strength of the structure. But even having all this assured, and having a perfect boiler, as soon as it is put at work, even with a moderate load, its deterioration begins and progresses at a rate depending upon its adaptation to the work, its settings and attachments, and the attendance after it is erected. Let us, therefore, have ample thickness, as well as good metal and good workmanship, and then have it well erected, well attended, and regularly inspected.

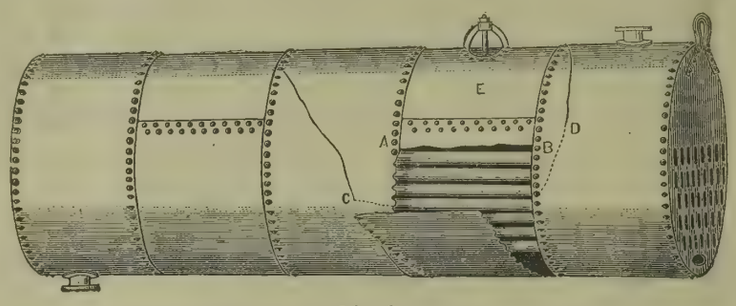


Fig. 1.

The initial break in this boiler was at the middle of a deteriorated plate A B, Fig. 1. It is probable that it was caused by frequent overheating, from being imperfectly set, the flame impinging upon the plate just above the water-line. The boiler was found after the explosion standing on end, leaning against the setting of its fellow, with the zone of plates shown in Fig. 2 hanging by the ends, which are represented in dotted lines below the letters C and D, Fig. 1, which are the same portions that are represented as bent and twisted at the right hand of Fig. 2, where the same reference letters C and D are cut. The complete separation of these plates from the rest of the boiler was effected in the process of dragging the whole from the ruins of the building by means of a chain attached to the narrow part of the plate. The building in which this boiler and its fellow stood was completely demolished, nothing remaining but the mason-work of the foundation and the flooring. After the zone of plates was partially torn off (hanging only by the narrow ends), the balance of the force was spent on the surrounding exterior objects, and no further damage was done to the boiler itself until an attempt was made to drag it from the ruins by a chain attached to the plates. The whole attending phenomena indicate that after the initial breach A B had reached a size sufficient to instantly relieve the boiler contents of pressure, the narrow end of the zone of plates, Fig. 2, was forced outward and downward, passed under the boiler, which was lifted by the reaction, while the plates were flattened as shown in Fig. 2, and left hanging by the bent and twisted ends, as described. The release of the water and its contained nascent steam and the free steam, was sudden and complete, owing to the weakness of the secondary lines of rupture traced on Fig. 1. The tearing off was effected by cross-bending, as the bark of a tree is unwound from the wood by pulling at a free longitudinal edge. No sufficient time of partial confinement of the water appears to have been allowed in which the force of the expansion could impel it (the water) in a concentrated mass in any one direction guided by parallel surfaces, and the rocket motion therefore could not be initiated, or otherwise one of the heads would have been torn off the tube ends.

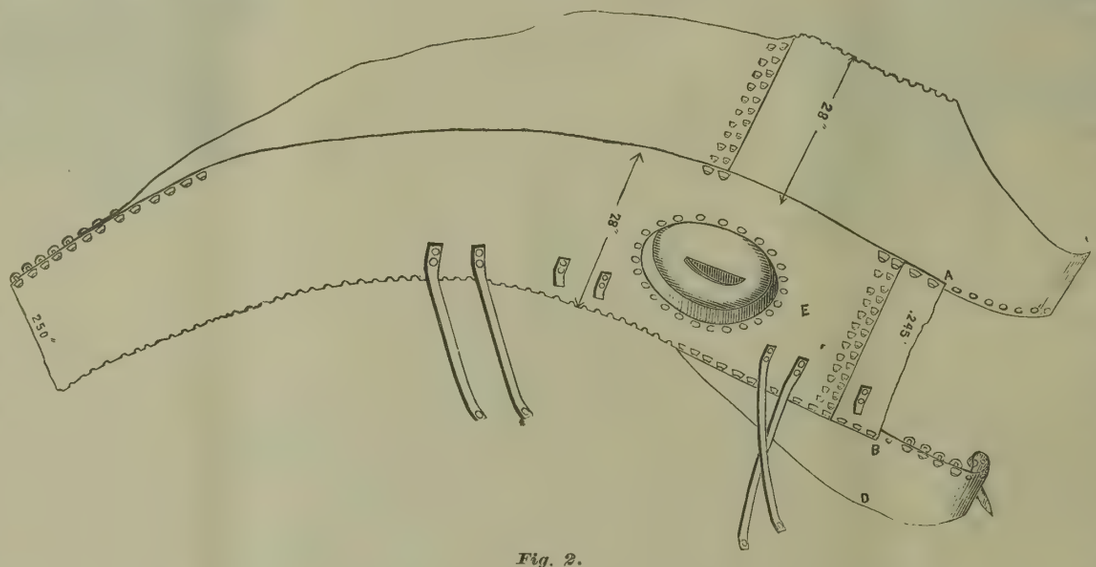


Fig. 2.

This case appears to verify the proposition that boilers exploding with a full supply of water, usually fly a distance governed by the quantity of water and the freedom or suddenness of its escape, and it may be to some extent directly, as the former, and inversely as the latter.

The foregoing is condensed from a more extended discussion of the case which appears in the monthly record of the Hartford Steam Boiler Inspection and Insurance Company.

Experimental Steam Boiler Explosions.

Mr. D. T. Lawson, of Wellsville, O., lately reports the results of an interesting experiment to test the correctness of certain ideas which he entertains respecting the cause of the explosion of some steam boilers. His theory is, as stated by one of our contemporaries, "that water raised to a high temperature, when confined and under pressure, will burst into steam when the pressure is removed from its surface; and if the exploding water meets resistance, as in a closed boiler, the effect of the concussion will be greater than the regular steam pressure."

To test the correctness of this theory, Mr. Lawson had constructed of the best materials and workmanship a plain cylinder boiler, 6 feet long and 30 inches in diameter, with heads of ⅝-inch flange iron, secured by a 1-inch stay rod running from one head to the other. The shell was three-16ths iron.

The boiler was set in an arch of brickwork, and was connected by a pipe with a closed cylinder into which steam could be admitted so as to suddenly relieve the water surface in the boiler from pressure. A valve controlling the admission of steam into this cylinder was so arranged that it could be operated with a cord in the hands of the observer stationed at a convenient distance from the scene of the experiment in a bomb-proof. The boiler was fired by means of petroleum, the supply of which from a barrel could also be regulated by the observer. A steam gauge connected with the boiler by a pipe some 40 feet long was also placed in the bomb-proof.

The experiment was made by filling the boiler with water 11 inches above the fire-line, and raising steam. When 260 pounds were registered on the gauge, the valve communicating with the cylinder was opened. The index of the gauge fluctuated violently some 30 lbs., showing that some extraordinary disturbance was going on in the boiler; but no explosion followed. The valve was then closed, and steam raised successively to 300 pounds, 335 pounds and 365 pounds, at each of which points the trial was repeated, but with similar results. At 380 pounds, however, the opening of the valve was followed by a violent explosion, which scattered the fragments of the boiler shell, furnace and stack in all directions.

The account from which we glean the foregoing facts, adds that there were evidences that the plates were rent at least four times transversely and torn open their entire length. One piece had a hole torn through it about the size of a man's hand. When it is added that the boiler was estimated to be able to bear safely a continuous pressure of over 700 pounds, the experiment appears to have demonstrated that the force required to violently explode it must have been greatly in excess of that registered on the gauge at the moment of the opening of the valve; and if the conditions of the experiment have been correctly re-

ported, Mr. Lawson, has beyond question, succeeded by this demonstration in establishing the correctness of his views respecting the dangerously violent development of steam in a boiler when the pressure is removed from its surface. We give in another column a memorandum respecting this particular theory, which appears to have been explained and advocated a number of years ago by Mr. J. W. Nystrom, a well-known writer on engineering. The credit of being the first to demonstrate its correctness experimentally, however, is undoubtedly due entirely to Mr. Lawson.

Manufactures and their Results.

The following article from the *Lumberman's Gazette*, of Bay City, Mich., while aiming at local interests, contains many suggestions from which other cities, similarly situated, may learn a lesson and supplant their languishing industries by manufactures which will promote their growth and materially improve the condition of their people:

The benefits of manufactures to a new city are very seldom fully realized, and the extent of the influence they exert upon the prosperity of a city is rarely properly estimated. While other things may exert an influence on the growth and prosperity of a community closely commingled, as they are in all cities, yet they may be transitory and unstable, and liable to almost continuous fluctuation. The influences of manufactories, however, are lasting and permanent. Manufactories create wealth and population as nothing else can. If any person entertains a reasonable doubt as to the proposition, he may easily undeceive himself by securing statistics and drawing comparisons between a city which depends in the main on commerce or any other similar industry and those which are dependent on the manufactories within their limits. Glasgow is strictly a manufacturing city, while Liverpool is mainly dependent on its commercial interests for its weal or woe. What is the result of a comparison of the history and growth of these two cities. Manufacturing Glasgow has outstripped her commercial sister in the race for population and wealth, and while Liverpool's natural advantages in the peculiar features which seem to make a commercial city of importance, are probably not exceeded by any city in the world, she has been unable to compete with her less fortunate sister in these respects, and as a consequence, Manchester to-day outranks her both in population and wealth.

The realization of the importance of manufacturing enterprises on the growth and prosperity of a city and concerted action on the part of its citizens about a quarter of a century ago imparted new life and vigor to staid old Philadelphia, and the consequence has been, that her growth during that time has savored something of the marvellous. Cohoes, N. Y., twenty-five years ago was a way station on the small branch of the Central railroad, running from Schenectady to Troy, with a population of less than four thousand. Her woolen, cotton and pin factories have increased her population to nearly twenty-five thousand at the present time. Troy, a few miles distant, is also another striking illustration of the influence of manufacturing enterprises on the growth and permanent prosperity of a city. During the last quarter of a century her population has increased from twenty to over sixty thousand. Her iron industries and other manufactures have conduced almost entirely to the result. The linen and paper collar factories of Troy supply a large percentage of these articles for the markets of the continent, while Troy stoves and nails are nearly universal. But it is useless to multiply instances of a similar character. The fact that manufacturing industries stand preeminently ahead of all other enterprises so far as their influence on the permanent prosperity of cities is concerned, is indisputable and undisputed. Under this potent influence, Bay City has advanced from the "slab village," of Lower Saginaw of a quarter of a century ago, to the Third City of the state with a population of nearly twenty-five thousand to-day. But it is conceded that the main industry which has conduced to this marvelous growth is in a certain sense of an evanescent character. The manufacture of lumber here in time will cease, not because of the lack of demand, but because of the lack of material, and the question which now most seriously concerns us is, what shall supply this industry when it shall die out. Of course the salt industry is permanent, and the source of supply probably inexhaustible. Not so, however, with lumber, and if we wish to maintain our present supremacy it is incumbent on us to see that this industry is supplanted by something of a permanent and enduring character. We fear, however, that our citizens are not alive to the importance of the question which so vitally affects the future of this city and the valley. The united and concerted action necessary for the introduction of manufacturing establishments does not seem so apparent as the necessities of the case demand. The natural resources which have stood us so well in hand in the past, will not suffice in the event of decay of the lumber industry. Some of the energy and preconcerted action which is apparent in other cities of the west, with the determination which animates the people therein, are among the necessities of the hour. One of two alternatives is inevitable, and it were folly and madness for us to attempt to ignore them. It is either the introduction of new and permanent industries and the retention of our present onward march, or a disregard of the necessity which so forcibly presents itself, and an ultimate receding from the proud position at present occupied by us. Which shall it be?

Water Glass.

In 1640 Von Helmont discovered that when in the preparation of glass from sand and alkali, an excess of alkali was used the glass dissolved in boiling water; but it was not until 1828 that water glass as now known was prepared and practically utilized by Von Fuchs, in stereochromy or solid color painting, in mural and monumental decoration, and for the preparation of various cements and artificial stones. Water glass, soluble glass, or silicate of soda, as it is variously called, possesses, when properly prepared, many unique and valuable properties. In cold water it is nearly insoluble, or dissolves very slowly. In boiling water it dissolves with facility, and remains in solution when the latter has cooled. Water containing 30 per cent of the glass in solution is of a syrupy consistence, and may be used as a transparent varnish on many substances; on drying it forms a glassy coating that resists moisture and change of temperature very well. It has been used extensively as a vehicle for certain pigments to form paints known as silica paints. These have the advantage over all paints or varnishes of being incombustible, and when used on wood-work serve in a measure to prevent sudden ignition of the wood by contact with flame. They are also serviceable in painting theatrical scenery, cloth saturated with a dilute water glass varnish becoming uninflammable. The pigments used in these paints are, zinc white, barytes, chrome green, chrome oxide, chrome red or orange, cobalt ultramarine, zinc yellow, ultramarine, cadmium sulphide, ocher, etc. Chalk mixed with water glass forms on drying a very compact stone as hard as marble; bone ash, zinc white, and magnesia with water glass form similar stones. Ransom's artificial stone is prepared by mixing sand with a water glass solution to form a plastic mass, which is pressed into the required shapes, then placed in a solution of calcium chloride; silicate of calcium is formed and cements the grains together, the chloride of sodium formed at the same time being removed by washing with water. In connection with clay, lime, sand, cement, etc., soluble glass enters largely into the composition of many of the patented artificial stones, plastic tiles, slates, etc.

The detergent properties of water glass make it an excellent scouring material, and it enters largely into the composition of most of our common soaps.

Water glass is best prepared by melting together in a crucible powdered quartz or quartz sand and carbonate of soda. Usually a small quantity of charcoal is introduced, but if the materials used are free from metallic oxides and compounds this is unnecessary.

Fine infusorial earth is nearly pure silica, and makes excellent water glass. Where quartz or sand is employed, it is reduced by grinding together with the calcined soda to a powder, the whole of which will pass through an 80-mesh wire gauze sieve.

The following are the usual proportions in which the materials are mixed:

1.	Clear quartz	45 pounds.
	Carbonate of soda, calcined	23 "
	Charcoal	3 "
2.	Quartz sand	100 pounds.
	Calcined soda	48 "
	Charcoal	5 "
3.	Quartz sand, purified	65 pounds.
	Anhydrous carbonate of soda	34 "
	Powdered charcoal	4 "

The ingredients, thoroughly mixed, are put into clay pots and gradually heated to bright redness; carbonic acid and carbonic oxide escape, and the mass gradually becomes liquefied. When effervescence ceases and fusion is complete, the contents of the pots are poured out on clean stone slabs to cool. When made of good materials and properly fused the glass closely resembles ordinary flint glass.

Cold water scarcely dissolves it at all, but if broken into small pieces and boiled in soft water it gradually dissolves. If the boiling is continued some time, and a sufficient quantity of glass is added, a clear syrupy liquid or a nearly colorless jelly, according to circumstances, is obtained. These solutions may be diluted with hot water.

The solution containing about 30 per cent of the glass is in greatest demand. It is quoted at 50 cents per gallon, put up in barrels or kegs.

Hemlock.

When hemlock comes into competition with pine it has to take a subordinate place, but alongside of the other soft woods it bears comparison favorably, It is being used more than formerly and serves excellently for bill timber, plank and rough boards. It is being utilized to a greater extent in Michigan than formerly and in New Brunswick lumbermen are beginning to appreciate its value. An operator at St. Stephen, N.B., recently stated that last season he received $5,000 stumpage for the bark on 2,000,000 feet, board measure, of hemlock logs. One of the principal builders of Frederickton, N. B., talks thus about the usefulness of hemlock as a wood: "For common kitchen furniture, I believe that the best of hemlock might be used very advantageously indeed. I think it is the best soft wood which we have for that purpose, pine of course excepted. It does not warp or shrink as much as spruce, and is easier worked. I have never made any coarse furniture from it as yet, but I am sure it might be used to a considerable extent for such purposes. For building material it might be used much more than it is. In 1851 I built a brick house in Frederickton, and put in hemlock for all the flooring joists, and I think there are no better floors in Frederickton to-day. Hemlock is superior to spruce for rough boarding or for board fencing, as the boards can be got wider than spruce, and do not require so many nails; and are not so liable to warp as those made of spruce. It dries very fast, and does not shrink quite as much as either spruce or pine. Hemlock might also be used for the inside finishing of houses, and is a very pretty wood when well oiled and varnished.

Recent Improvements in Wood-Working and other Machinery.

Continuing the description of recently patented inventions, which we select chiefly from the department of wood-working machinery, we call attention this month, first, to the improvement in feeding appliances for saw mills devised and patented by Gilbert Mee, of Muskegon, Mich.

This invention relates to that class of appliances used in saw mills for the purpose of imparting a reciprocating movement to the log-carriage, by the direct action of a piston reciprocating within a suitable steam cylinder, the object being to obtain the desired longitudinal movement of the log carriage from a much shorter stroke of the steam piston, and at the same time prevent danger of breakage to any part of the the mechanism when the movement of the piston is suddenly reversed, by causing its attachments to the log-carriage to be of such a nature that they will readily yield to any unusual strain, and afterward automatically readjust themselves to their position and tension; and the invention consists, essentially, in the combination, with a log-carriage and the steam cylinder and piston by which it is reciprocated, of weighted or spring-attached ropes running over suitable sheaves and connecting the piston rod and carriage.

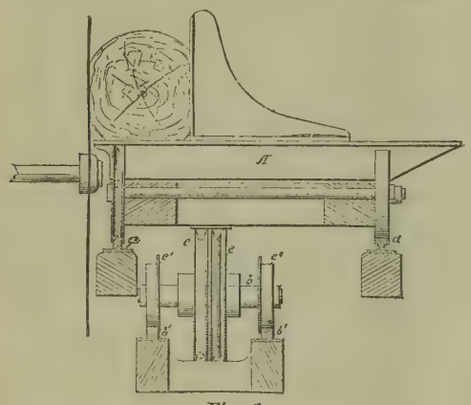


Fig. 1.

This device is represented by Fig. 1. The steam cylinder is placed beneath the log carriage, and provided with piston, piston rod and a bifurcater crosshead carrying sheaves *c c'*, for the purpose of imparting a reciprocating movement to the carriage; and the special feature of the invention is the combination in feed appliances for saw mills, of a steam cylinder and piston, having a shorter stroke than the longitudinal movement of the log carriage, with the carriage, and with a system of weighted or spring attached feed and gig ropes arranged for the purpose of imparting a reciprocating motion to the carriage.

Fig. 2 represents certain improvements in lathe chucks patented by Dwight Slate, of Hartford, Conn., who assigns his invention to the well known E. Horton & Son Co., of Winsor Locks, Conn.

This invention relates to that class of combination chucks—that is, those which may be changed from universal to independent, and *vice versa*—which have an annular gear for engaging with pinions on the various screws which operate the jaws and a loose ring back of the annular gear for use in meshing and unmeshing the annular gear from such pinions. The improvement is a device different from those which have preceded it for causing the meshing and unmeshing of said annular gear and said pinions.

This invention consists substantially in the combination of the annular gear *f*, the loose ring *g*, provided with recesses *h*, and the radial slot *i*, the chuck body half *b*, provided with cams *h'*, and the slot *n*, together with the disk *l* provided with the operting button and crank pin and springs *o*.

Figure 3 represents an improvement in molding machines designed for molding spiral objects patented by James Anderson, of Boston, Mass.

This improvement relates to machines for forming spiral moldings upon stairway-posts and similar articles, which work has heretofore been generally done with a lathe by using a hand tool. The object of the invention is to accomplish such work by automatic mechanism and by devices which allow variations in the character of the ornamentation to which

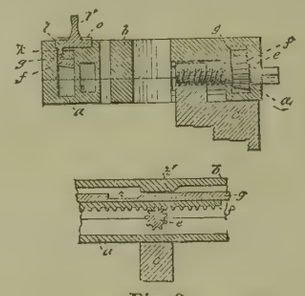


Fig. 2.

ends the inventor constructs a lathe combining feed mechanism for giving spiral movement to the work and a revolving cutter-head. The invention will be understood from the following abridged statement of the inventor's claims: The end B of the machine is provided with the revolving feed-screw *i*, and centers *c'* b^3 a worm shaft *r*, wheel *s*, arbor C, and connections with the feed-screw. Furthermore, in spiral molding machines, he claims the revolving shaft n^2, the beveled pinions *m m'*, the suspended bracket *n*, and threaded arm *n'*, in combination with the feed screw *i*, and work carrying bed B. He claims also the adjustable hub *d*, provided with arms *e*, and arbor *f*, carrying the cutter in combination with the driving shaft *w*, and driver *h*.

Figure 4 represents an improvement in drag sawing machines invented and patented by David H. Ball, of Renno, Pa. It consists substantially in the vertical gauge post A, and the laterally projecting brackets C C' provided with pintils *c c'* designed to receive detachable and changeable gauge arms D.

Fig. 5 represents certain improvements in log sawing machines patented by Clark B. Halstead and James A. Carpenter, of Marion, O. The invention consists of a supporting frame which is provided with prongs to enter the log in connection with which is an oscillating sweep carrying a saw working through a suitable slot in a hanger secured to a bar loosely connected to the supporting frame and against a friction-roller mounted in an opening in said hanger, and the tongs and their operating mechanism, adapted to work in connection with the prongs on the

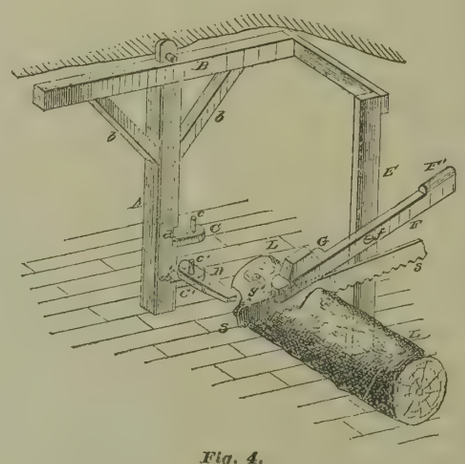


Fig. 4.

frame to hold the log. The forward end of the apparatus is secured to the log, the rear end resting on the ground. The saw is then adjusted in its guide, and by means of the handle and swaying beam B, is traversed back and forth over the log.

Fig. 6. shows certain improvements in saw filing machines designed and patented by Clarence F. Putnam, of Cheyenne city, Wyoming Terr. The inventor seeks in this device to provide a simple means of adjusting a detachable saw-filing rim to a suitable wheel, and operating the same in connection with an adjustable saw-rest and guides, whereby regular directions and angle of file-stroke together with uniform depth of cut will be secured. In this apparatus a circular file-rim that is beveled and screw-threaded on its inner surface may be detachably secured to the corresponding screw-threaded beveled edge of the wheel E, in such a manner as to remain firmly in place, while the said file-wheel is in operation. The construction of these file-rims is such that, while they are capable of being quickly and securely attached, they may be as readily removed for the purpose of substituting others having an exterior face or faces of different conformation, so that a file-rim having the requisite shape or angle is easily adjusted for operation in sharpening saws having teeth of any form desired. It will be seen that an endless variety of file-rims may be employed in this manner, according to the character of the work required.

Figure 7 shows an improvement in boring machines invented and patented by Benjamin F. Allen, of Boston, Mass. The boring-arbor is rotated by means of a belt running from the pulley to any suitable motor. Devices are also connected with the ar-

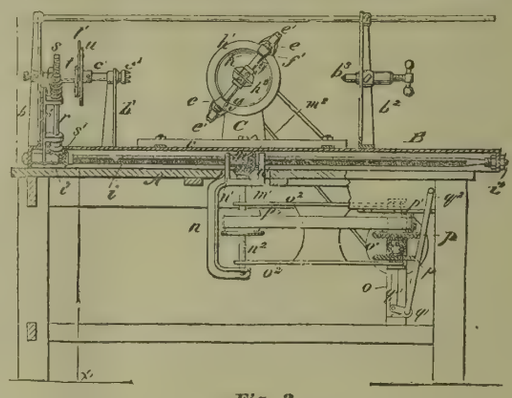


Fig. 3.

bor by means of which a longitudinal movement can be imparted to it, and by which it is retained in proper position, its axis coincident with that of the sleeved journals when not in the act of boring. The material to be perforated is then placed in position, and the boring-arbor caused to advance. As at the commencement of this advance the axis of the boring-arbor and sleeve journal coincide the boring-bit will enter the wood directly, but as it advances it is thrown out radially by the action of the inclined grooves and splines, and describes a circle around the axis of the sleeve journal proportional to the distance it is moved from the central line. This causes the perforations to be enlarged, and the outer end of the boring-bit having the greatest diameter, of course the inner end of the perforation is correspondingly enlarged. When the boring arbor and bit are withdrawn they follow the same course as when brought forward, the large end of the bit, when it arrives at the point where it first perforated the wood, revolving upon the same axis as the sleeve-journal, passes out without enlarging the outer end of the hole, thus enabling the machine to bore conical holes with the same rapidity as the ordinary cylindrical ones are bored, the machine by which it is accomplished being simple, durable, and cheaply constructed.

Fig. 8 represents a gear molding machine, patented by J. Walker.

BOILER EXPLOSIONS.—An ex-engineer writes to the *American Machinist* as follows, respecting one phase of responsibility for boiler explosions: "I have seen new boilers that ought to have been repaired before leaving the shop, yet they were sold for first-class work. I have lately had repaired an upright boiler

in use three years—bought for first-class, but it caused continual trouble from leakage. It was taken to the shop, the rivets cut out and ring removed, which was found to be full of large blow holes filled with lead. The rivet holes in the fire box and outside sheets were cracked entirely through. I saw the job while progressing, in order to satisfy myself of the quality of the work being done."

The Luxurious Employment of Wood Among the Ancients.

The following is an extract from the National History of Pliny Secundus, who lived rather more than 1,800 years ago: Mount Atlas, on the northwest coast of Africa, possesses a forest of trees of a peculiar character. In the vicinity of this mountain is Mauritania, a country which abounds in the citrus, a tree which gave rise to the mania for fine tables, an extravagance with which the women reproach the men when they complain of their vast outlay upon pearls. There is preserved to the present day a table which belonged to M. Cicero, and for which notwithstanding his comparatively moderate means, and what is even more surprising, at that day too, he gave no less than 1,000,000 sesterces (about $45,000).

We find mention made also of one belonging to Gallus Asinius, which cost 1,100,000 sesterces. Two tables were sold by auction which had belonged to

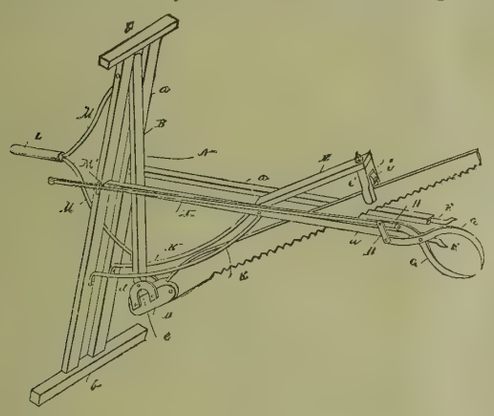


Fig. 5.

King Juba. The price fetched by one was 1,200,000 sesterces, and that of the other something less. There has been lately destroyed by fire a table which came down from the family of the Cethegi, and which had been sold for the sum of 1,400,000 sesterces the price of a considerable domain. If any one indeed could be found who would give so large a sum for an estate. The largest table that has ever yet been known was one that belonged to Ptolemæus, King of Mauritania; it was made of two semi-circumferences joined together down the middle, being four feet and a half in diameter, and a quarter of a foot in thickness. The most wonderful fact, however, connected with it was the surprising skill with which the joining had been concealed, and which rendered it more valuable than if it had been by nature a single piece of wood. The largest table that is made of a single piece of wood is the one that takes its name (Nomiana) from Nomius, a freedman of Tiberius Cæsar. The diameter of it is four feet, short by three quarters of an inch, and it is half a foot in thickness, less the same fraction.

While speaking upon this subject, I ought not to omit to mention that the Emperor Tiberius had a table that exceeded four feet in diameter by two inches and a quarter, and was an inch and a half in thickness. This, however, was only covered with a veneer of citrus wood, while that which belonged to his freedman Nomius was so costly, the whole material of which it was composed being knotted wood. These knots are properly a disease or excrescence of the root, and those used for this purpose are more particularly esteemed which have lain entirely concealed under ground; they are much more rare than those that grow above ground; and that are to be found on the branches also. Thus, to speak correctly, that which we buy at so vast a price is in reality a defect in the tree. Of the size and root of it a notion may be easily formed from the circular section of its trunk. The tree resembles the wild female cypress, the European cypress (*cypressus sempervirens*)

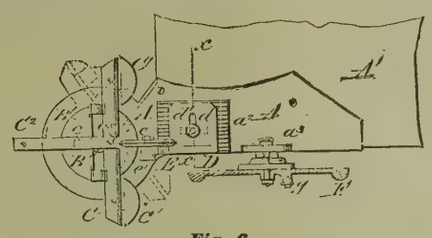


Fig. 6.

in its foilage, smell, and the appearance of the trunk. A spot called Mount Ancoraius, in Nearer Mauritania, used formerly to furnish the most esteemed citrus wood, but at the present day the supply is quite exhausted. The principal merit of these is to have veins (the grain or figure) arranged in waving lines or else forming spirals like so many little whirlpools. In the former arrangement the lines run in an oblong direction, for which reason these are called "tiger' tables; while in the latter the marks are circling and spiral, and hence they are styled "panther tables." There are some tables also with wavy, undulating marks, and which are more particularly esteemed if these resemble the eyes of a peacock's tail.

Next in esteem to these last, as well as those previously mentioned, is the veined wood, covered as it were, with dense masses of grain, for which reason these tables have received the name of "apiatæ," or "parsley seed" tables. But the color of the wood is the quality that is held in the highest esteem of all next to which it is the size that is prized. At the present day whole trunks are greatly admired, and sometimes several are united in a single table.

Boiler Explosions in 1881.

The boiler explosions in 1881 that were of sufficient importance to attract the attention of local press reporters were not as great by about half a dozen as were reported in 1880. But the number is quite sufficient, being 160 explosions, by which about 250 persons were killed or fatally injured and died soon after from the effects of their injuries, while over 300 more were seriously but not fatally injured.

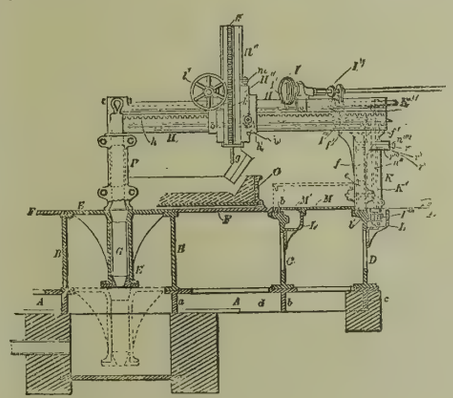


Fig. 8.

Of these explosions almost exactly thirty per centum were in mills that use light and quick burning fuel, saw mills standing far ahead of any of the class in number and disastrous results. The class includes besides saw mills, all such as use refuse timber and shavings from wood cutting machinery, and should also include such thrashing engine boilers as are fired with straw.

Next in order of their numbers and effects come the explosions in iron works of various kinds. Something less than 11 per centum of the exploded boilers were in this class of manufactories. The most notable explosions were in rolling mills and furnaces, but for convenience in classification, boiler shops, machine shops, and foundries are included in this class.

Railroad locomotives usually stand near the head of the list, generally in the third place, but last year only about seven per cent of the explosions were locomotives; thirteen only were reported, and the same number stands against steamers. Portable engine boilers, hoisters, pile drivers, and thrashing machines stand third in last year's classification, which is not surprising in view of the extended introduction of agricultural and thrashing engines. In distilleries, breweries, soap and candle works, and the like, there were eleven boiler explosions. In steam heating and drying and in dwellings there were seven cases of disaster. In bleacheries, dyeing, digesting, and other works where steam and water are used in vessels remote from the generator, there were six cases of destructive explosions. In the ninth item in this classification, viz., paper mills, flour mills, grist mills and grain elevators, there were *five* explosions. In the tenth—cotton, woolen, and knitting mills—*four*; in mines, oil wells, etc., *three*; while there were

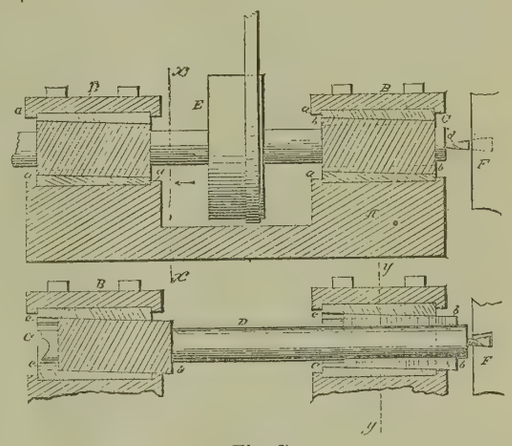


Fig. 7.

nineteen explosions in other mills and works not characterized in the press reports.

RECAPITULATION.

	Explosions in 1881.
Sawing, planing, and woodworking mills	48
Iron works	17
Portables, thrashers, hoisters, etc.	15
Steamers, tugboats, etc	13
Locomotives	13
Distilleries, breweries, soap works	11
Dwellings, steam heating and drying	7
Bleaching, boiling, digesting and dyeing	6
Grist, flour, and paper mills, and grain elevators	5
Cotton woolen, and knitting mills and factories	4
Mines, oil wells, and works	3
Mills and works not classified and those not characterized	18
	160
Number of persons killed	250
Number of persons injured	328

CHEAP ENGINES.—Cheap engines are made and sold solely because there is a demand for them and purchases will not pay for honest work at fair prices. There are plenty of good, small engines on the market for those who will pay for them, but the average man will not. He expects to buy finished work for about the price per pound of rough castings—that is where the trouble lies. To lump all builders of small engines together, and condemn all for the failure of

one, is hardly consistent. It is unjust. If a man buys an engine because it is cheap and finds it unsatisfactory, whose fault is it? If he buys a cheap engine at a dear price, whose fault is it? His own, every time.

The American Iron Trade.—The report of the Secretary of the American Iron and Steel Association, which has just appeared, gives a very encouraging and satisfactory picture of the American iron trade during the year just passed.

The product of our blast furnaces reached the hitherto unequalled figures of 5,000,000 tons. The prices during the year were fair and well maintained. The iron masters had less stock on hand at the close of the year than at the beginning, and orders are so numerous that the outlook for the present year, points to a continuance of the prosperous condition of 1881.

Scientific.

The Development of Electricity as a motive Power is an aim which, though difficult of realization is yet strongly to be desired. Its achievement is not so very far off, if we may take the utterances of some of the best authorities on the subject as conclusive evidence of the probabilities of the future. For example, M. Bontonx, presiding recently at a meeting of the Parisian Society for the Utilization of Electric Force, observed that the artisan who needs a little motive power for his work, is forced to seek it in the employer's factory, while thousands of workmen and workwomen wear out their bodies and destroy their strength in impelling the sewing-machine-the lathe, and the other motive powers of small industry. The division of electric energy is destined to effect an entire revolution in this sphere. The day will come, and sooner than is imagined, when the artisan family will see enter their dwelling by means of a magic wire the force which is now so costly to them, and this will be the democratization of force for the benefit of the working class. The solution of the question of motive force in mechanical industries is by this apparently not far distant, and it is curious to contemplate the changes in our social and public arrangements which such a development of the electric motor would accomplish. If an efficient, actuating agent for small machines of every kind could be readily obtained and cheaply purchased, what a revolution would come over the existing labor market? How many workshops for men and workrooms for women would be closen, and quondom employés supplied in their own homes with the means of carrying on their work in their own apartments. Without attempting to foreshadow all that might happen, certain it is that the cost of driving lathes and machines of every kind would be largely diminished, and the means and motive for extending their application supplied. From all points of view it is much to be wished that this novel mode of actuating machinery may be developed so that its efficiency and economy may establish a reputation, and be largely patronized by both large and small employers of labor.

Influence of Cold on the Voltaic Arc.—A series of observations of the voltaic arc as affected by a cooling current of water has been lately made by M. Tommasi, who used as rheophores (*i. e.*, carriers of the current) two U-shaped copper tubes, placed horizontally opposite each other, and traversed by cold water. Under these circumstances the luminous power of the arc is considerably weakened, being reduced to a mere luminous point, even when the very intense current of 50 to 75 large Bunsens is used.

The arc is also very unstable. The least puff extinguishes it. A sheet of paper placed above it at a distance of about one-fifth of an inch acquires in a few seconds a black spot, which extends, and is before long perforated, but the paper is not ignited, The arc is formed of a luminous globule, moving up and down between the rheophores. Its form and its great mobility recall the sphroidal state of liquid drops. If the south pole of a magnetized bar be brought near, the arc is attracted and may go out. The north pole has an opposite effect. The quantity of ozone seems to be greater than when the arc is not cooled. In spite of the cooling the flame of the arc is slightly green, showing that a part of the copper is burnt.

Camphor.—At a late meeting of the German Technical Society, an active Philadelphia organization, Mr. G. F. Bihn, Chemist to the Pennsylvania Salt Works, read the following highly interesting paper upon camphor, how it is refined, and its uses, which we translate for the readers of the Manufacturer and Builder:

The technical literature upon this theme is scant, and the purification of camphor was for a long time regarded as a trade secret. It was customary formerly to designate by the name camphor a variety of solid volatile substances, derived partly from the animal and partly from the vegetable kingdom, and particularly certain solid substances yielded by many ethereal oils after exposure to the air, such as Bergamont, oil-camphor, Tonka camphor, etc. Many hydro-carbons in combination with hydrochloric acid, such as the Terpen-chlorhydrates, were likewise called camphor, from the similarity of their smell to that of the natural camphor.

All of these bodies have, however, received some other designation in modern chemistry, and the name of camphor is at present confined to certain products derived from the vegetable kingdom, and distinguished by their volatility and peculiar aromatic smell. These are: 1st. Japan camphor, which is brought into the market simply under the name of camphor, and is obtained chiefly from China and Japan. Its chemical composition is $C_{10}H_{16}O$. 2d. Borneo camphor (composition $C_{10}H_{18}O$) is obtained chiefly from Borneo and Sumatra. The entire production of this article—about 3,000 pounds—with trifling exceptions, finds its way to China, in which country it is highly prized for its medicinal virtues, and where it commands a high price. One pound of Borneo camphor commands from fifty to eighty times the price of ordinary camphor. 3d. Blumea camphor, derived from a plant which grows in the East Indies, likewise finds its way chiefly to China, where it is used partly as a medicinal agent and to some extent also to perfume the so-called India (or China) ink. Its price is about ten times that of ordinary camphor, for which reason it is not a common article of commerce. Its chemical composition is identical with that of Borneo camphor.

These three varieties embrace many of the substances that are at present known by the name of camphor. The only variety that is of importance in the arts is the variety known as Japan camphor. It exists in the leaves, flowers, wood and roots of *Laurus camphora*, and is obtained either by making incisions in the bark—where it is designed to spare the tree—or by felling the tree. A number of other plants likewise yield camphor, as, for example, the majoram, lavender, sage, rosemary, etc. The camphor separates from the ethereal oils obtained from these plants by long standing.

Camphor is formed likewise by the action of nitric acid on many ethereal oils; it is formed also by continuous boiling of amber with nitric acid; also by treatment of turpentine oil with permanganate of potassa; and it is formed likewise from many substances by treatment with appropriate chemical reagents.

The production of camphor on the island of Formosa, in Japan, and in China, is conducted, even at present, in a very irrational manner. The finely split wood of the camphor tree is exposed to the vapor of boiling water, with which the camphor volatilizes. For this purpose the fragments of camphor wood are placed in a suitable vessel (or boiler), covered with water, and upon the vessel is placed a cover or pot of clay, partly filled with straw. Upon heating the water sufficiently, the camphor is volatilized and deposits itself as a gray or reddish, fine-grained powder between the pieces of straw, from which it is afterwards separated by sieving. The crude camphor obtained in this manner comes into market in chests lined with lead foil, and of about 140 to 150 pounds weight, or in tubs containing about 200 pounds.

It will surprise no one to know that with a substance so comparatively costly as camphor, adulterations are very common. Stones, sand, but chiefly finely pulverized salt, are frequently found in the masses of the crude material, which occasionally contains only enough camphor to conceal the fraud. (It is said that a Boston manufacturer found the head of a negro in a chest of this substance.) Another mode of adulteration consists in moistening the crude material, while being packed, and afterwards while in transport, with water, of which the camphor takes up a considerable quantity. The purpose of this form of falsification is obviously to secure an increase of weight.

According to another method of obtaining camphor, which appears to be now generally practiced, the finely chopped fragments of the wood and of the roots of the camphor tree are placed in an iron boiler, which is provided with a high wooden attachment; a very small quantity of water is added, and the vapors that are evolved, by a moderate and prolonged heating of the boiler, are condensed in a closed condensing chamber partly filled with water. Camphor and camphor oil condense and collect on the surface of the water in the condensing vessel, and at the close of the operation are removed. The camphor oil, which makes about 25 per cent of the product, is pressed out from the camphor, and in spite of its powerful odor and the smoky flame it yields, it is used by the poorer classes as an illuminant. The spent camphor-wood chips serve as fuel for heating the boiler for subsequent charges.

The refining of the camphor, until within the past few years, was conducted in quite as primitive a manner as the preparation of the crude product. The chief condition of the purification of crude camphor by the old methods, was to secure the complete removal of water, which could only be accomplished by subliming it over freshly burned lime, when the sublimed camphor attached itself to the upper part of the sublimation chamber. For this purpose a number of glass flasks, with slightly flattened bottoms and wide necks, each capable of containing from 4 to 6 pounds, were filled about half full with the crude material, the necks were carefully freed from particles that might have attached themselves, and they were then placed upon a sand bath (50 or 100 together), and the camphor was slowly sublimed and condensed in the upper part of the glass flasks. For this operation it was very important to regulate the fire. If it was allowed to become too hot, the sublimate was remelted and fell back again to the bottom of the flask; and if the heat was not great enough, the camphor sublimed in snow-like masses, in which form it was not a desirable commercial article. When the operation was finished, it was necessary to break the flasks to get at their contents, and the glass fragments had to be carefully separated from the adhering camphor by hand.

By another method of purification, which was, however, the same in principle as that just described, the sublimation was effected with the aid of iron vessels. Here the uncertainty was complete, as the operation could not be seen, although, on the other hand, the apparatus was not lost. The cover of the vessel required to be made of some material that

would not rust, or to be lined with a covering of this character, in order that the product should have a commercial value. Lead-lined iron chambers have been proposed for this purpose, in which the leaden lining with adhering sublimed camphor could be withdrawn, the camphor broken off, and the lead lining returned; but the method was found to be troublesome and laborious.

Another method involved the sublimation of the camphor in a separate chamber, in which it was melted; but this was found to be attended with the difficulty that sublimates of various densities were obtained, and the resulting product was not uniform in quality.

Lately, however, a process has been devised by Mr. William Simes, a Philadelphia druggist, which differs in many essential features from those that have been described, and which is at present being worked on a large scale very successfully. With all the methods thus far described, we have seen the complete desiccation of the crude substance was the important preliminary step. In the process of Mr. Simes the object is to obtain the sublimate in the form of a finely pulverulent snowy mass, for which purpose about one-tenth per cent of water is generally added to the crude material before sublimation. The apparatus of Mr. Simes consisted of a flat iron chamber, capable of holding about 200 pounds, which was connected by means of an iron tube with a condensing chamber 8 feet long, 4 feet wide and 4 feet high, constructed of heavy glass plates, in which the sublimed camphor was collected. After an operation was finished, the apparatus was allowed to remain undisturbed over night, to become sufficiently cool, and the next day the sublimed camphor was removed and subjected in molds to a pressure of 2,500 pounds per square inch in a hydraulic press, and the finished product obtained in small cakes highly compressed, and weighing one ounce.

Mr. Bihn here exhibited for inspection a number of such cakes of compressed camphor.

As Mr. Simes felt the need of facilities for carrying on his method on a large scale, he shortly arrived at an understanding with the Pennsylvania Salt Manufacturing Co. to undertake the manufacture of compressed camphor extensively, and Mr. Bihn was called upon to construct an apparatus capable of working from 2,000 to 3,000 pounds per day.

The kind of apparatus for volatilizing the crude material gave no trouble. For this purpose he introduced a cylindrical steam boiler 20 feet long and 4 feet in diameter, which was provided with the necessary openings for filling and for the escape of the volatilized camphor. The boiler is so set that it is not touched at any point by the direct fire, and to this end it rests throughout its entire length upon an arch of fire brick, and the flame is kept under complete control by means of dampers. The construction of the condensing chamber gave considerable trouble, since, on account of its size, the use of glass plates was not to be thought of. On this account, Mr. Bihn constructed the condensing chamber of leaden plates weighing 6 pounds to the square foot, in the same manner as those are used in the lead chambers employed in the manufacture of sulphuric acid. This condensing chamber was connected with the distilling vessel by means of an iron tube 15 inches in diameter, and the door of the condensing chamber was closed hermetically with the aid of rubber strips.

Upon the completion of this plant, including steam boiler, condensing chamber, steam engine, press, etc., the manufacture was started. Meantime a magazine specially constructed for the purpose had been built, in which was stored crude camphor to the value of about $100,000. The magazine was provided with a double roof, in order to guard as much as possible against the very considerable loss of the material by volatilization in the summer months. In spite of this provision, however, the loss is a very considerable one. In summer it amounts to 8 per cent, during the spring and autumn it is about ½ to 1 per cent, while in winter the loss is inappreciable.

Soon after the manufacture was under way, it became evident that the construction of the condensing chamber of lead plates was a mistake. A stratum of camphor of about ¼ inch thickness, which adhered firmly to the plates, was found to be strongly impregnated with lead, while that accumulating on the bottom was free from impurity.

It required constant and careful attention to separerate the lead impregnated crusts falling from the roof and walls of the chamber from the pure sublimate. By an unfortunate accident the condensing chamber, with the press room together with a portion of the machinery was burned down, the distilling apparatus, and steam engine were uninjured.

In re-erecting the plant, Mr. Bihn profiting by his former experience, constructed the condensing chamber, of enameled bricks set in Portland cement, forming the arched roof, and the floor of the same material. The new condensing chamber was made 30 feet long, 16 feet wide and 11 feet high. The chamber is strengthened with iron sheathing, the doors are of iron and double, and the whole construction fireproof.

The operation as now conducted is as follows; The distilling chamber is charged with about two tons of crude camphor, all openings carefully closed and distillations gradually effected. The operation requires generally about 15 hours, and usually three operations are conducted in rapid succession. The apparatus is then left undisturbed for 24 hours to cool off, before the condensing chamber is opened.

The snow-like masses of camphor, often 20 to 24 inches deep, are then removed and either packed in barrels for sale as they are, or burned into cakes 12 inches square and about ¾ inch thick in the hydraulic press under a pressure of 2500 pounds to the square inch.

The compressed cakes are then sawed with a band saw into rectangular blocks weighing one ounce, each of which is wrapped in paraffine paper, and thereupon packed in boxes holding various quantities. The boxes holding 2 pounds, find the largest sale. The advantage of the compressed camphor is chiefly that it does not volatilize as rapidly as the pulverulent or granular masses obtained by the usual methods of sublimation here described.

Celluloid Printing Plates.—The production of printing plates of celluloid, which we noticed in last month's issue as an interesting novelty just about being introduced in this country, is successfully practiced on a large scale in France, where it is at present attracting considerable attention. A French inventor, M. Jannin, has, according to published accounts, in the technical journals of that country, succeeded in producing remarkable results in products of such celluloid printing plates (clichés), both from wood engravings and from type. These are said to possess great fineness, and to be considerably more durable in service than either metal stereotypes or electrotypes.

M. Jannin's process consists in taking a copy of the engraving on wood or of the type, with the use of a special cement, which hardens rapidly and takes the finest lines sharply. After about twenty minutes this cement is said to be hard and resistant enough to withstand a pressure of 500 kilogrammes. The press in which this first impression is taken should be slightly heated, and a sheet of celluloid is employed to obtain [with the aid of heat and pressure ?] a counter impression from this, which is then prepared by ordinary methods for the printing press.

M. Jannin is reported to have succeeded by his method in obtaining marvellously fine results, and is now engaged on a large scale in making celluloid reproductions of letter text, engravings of all descriptions, bas-reliefs, medals, and imitations of carvings in ivory.

The work by this process is said to be executed very rapidly. A Jannin cliché can be made within an hour, while to make a good electrotype by the processes now in in use requires thirty hours. [This last estimate is erroneous; a good electrotype can be made from type or engravings and blocked ready for the press in less than half that time.—*Ed. Manufacturer and Builder.*]

Trials lately made of celluloid typographical plates are reported to have been very satisfactory, one cliché of celluloid served to give 25,000 impressions of an illustrated journal, and was found to have suffered no appreciable danger from this severe ordeal in the press, thus proving the remarkable durability and resisting qualities of the material. This resisting quality of celluloid is doubtless largely due to the eminent elasticity of the substance.

The price of the Jannin cliché, an important element in estimating the practical value of the process, is reported to be less than that of ordinary electrotypes.

Another New Application of Celluloid is for the production of printing type, to take the place of the large types for poster printing and other work requiring display, and which have hitherto been made of wood. The new type is called by the manufacturers cellu-wood type, and consists of a celluloid face mounted on and cemented to a wood body, or keyed fast to the wood by projecting tongues fitting into grooves in the block to obtain additional security. All kinds of plain or ornamental type can be made of this material. The new type has a good appearance, a fine surface, and appears to be well adapted for its intended uses. The hardness, toughness and elasticity of celluloid are qualities that will doubtless give the new type great durability in service; and its indifference to the action of chemical agents and its non-absorption of moisture render it suited to print in all colors without injury to the quality of the work. The celluloid type can be readily washed and cleaned, is light, and is enabled to stand the roughest usage in the press. The makers are the Cellutype Company of this city, who claim that in time their improved type must supersede all other kinds of block type.

Selenium as a Heat Regulator.—The sensitiveness of selenium to radiation is to be made use of in regulating the heat of muffle furnaces. The concentration of rays, more or less, upon selenium, influences the electric conductivity of the material, as most people know, in a marked degree and this property M. Germain proposes to make use of to control the heating of furnaces. A window in the furnace, made of very refractive alumina glass, permits the red glow to reach a distant mirror; the rays are reflected upon selenium, and when the light reaches a certain stage of brightness the electric action of the selenium conductor is such that it acts on a mechanical arrangement by which the fire-bars of the furnace are withdrawn. The fuel of the furnace is thus allowed to fall out as soon as the right temperature for fusing enamels has been reached. The *Photographic News* says: If a self-acting selenium actinometer of this kind will permit the firing of enamels with certainty, photographers will not be slow to avail themselves of it.

Siemens Process for making Iron Directly from the Ore, is reported to be in successful operation in an extensive establishment in Pittsburgh, Pa. The process has only been in operation for a short time, but the results are stated on the authority of the *Engineering and Mining Journal* to be very satisfactory. The successful operation of a direct process is an event of special importance, and therefore worthy of notice. We shall present the facts respecting this process as soon as they are available for publication.

Design for Cottage Costing $800.

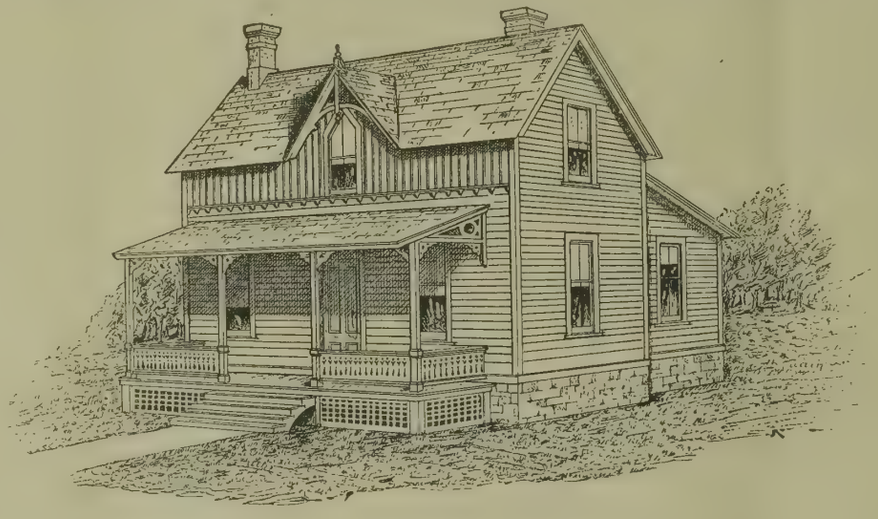
Those readers of the Manufacturer and Builder who have expressed a wish that we publish a plan of a small house that can be erected for what they call a very low sum, will doubtless be pleased with the design herewith presented, for it is seldom that so satisfactory an arrangement of rooms is given with such comfortable-looking exterior in a building whose cost is but $800. Nothing gives a man a greater feeling of independence and self-respect than the possession of a home he has paid for by his own thrift; and there must be few, if any, of our readers who cannot realize in themselves this enviable feeling with such opportunity before them as is here offered.

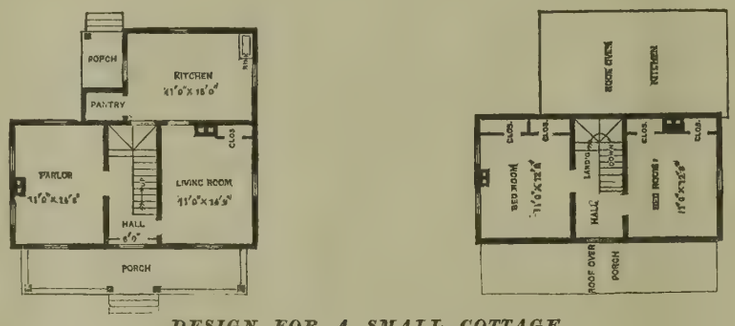
The plans indicate on the part of the designers an evident appreciation of the use for which they are meant. Space has been economized and unnecessary angles in rooms have been avoided, while at the same time there is nothing cramped, and there is a generous provision of closets.

The position of the hall makes it unnecessary to pass through one room to enter another, as all the rooms open into it directly.

A cellar, under the living-room and hall, is reached by stairs placed underneath the main staircase.

The design is by Messrs. Smith & Howe, architects, of 7 Warren street, New York.





DESIGN FOR A SMALL COTTAGE.

The Sugar Beet Industry.

A Paper by Lewis S. Ware and Robert Grimshaw, Presented at the National Tariff Convention, New York, Nov. 30, 1881.

The futures of nations and inventions are difficult to predict, both being controlled by unknown causes. Who, during the prosperous days of the Byzantine or the Roman empire, would have thought that a few hundred years would have swept it almost totally out of existence? Who, again, could have predicted, during the reign of George III., when this important English colony became independent, that it would later on be the leading nation of the world? What would prehistoric peoples have thought of the possibility of our recent scientific discoveries? In the same line of argument, what have these coming years in store for us? Is a foreign blockade of our eastern coast possible? or are Southern or Western difficulties near at hand? We cannot foresee. Whatever occurs, the commodity in greatest demand should be the first thought of. In the present condition of our commerce, sugar is the greatest imported commodity, and to that so-called luxury we should give our first thoughts.

In the South, the total sugar made in 1880 was about 200,000,000 pounds, while our total consumption was about 2,000,000,000 pounds; thus, in round numbers, we rely upon other countries for nine-tenths of all the sugar we consume, at a present annual outlay of nearly $100,000,000. Whatever occurs, the Southern production is ample for Southern requirements. By present treaties with the Sandwich Islands, their Pacific sugars enter our ports free of duty, thus practically rendering the Western markets independent of the South, while under the present conditions the Northeastern States have nothing upon which to rely in an emergency. Is not Northern sugar production desirable? Napoleon I. foresaw the importance of protecting France, from a sugar point of view "His method," said the great Thiers, "thrice saved the country from ruin." We propose that America follow it, ignoring the unknown future and examining the present conditions of our sugar-growing interests. We notice that in our ninth decade, 28 pounds of sugar per capita per annum were consumed, while, from the present appearance, by the end of the eleventh decade it will be over 50 pounds (this is 10 pounds less per capita than is consumed to-day in Great Britain). Our reasons for supposing that it will reach that figure, are that statistics prove that annual sugar consumption per capita increases with population and material wealth. In our tenth decade it was nearly 40 pounds per head, and if our population increases at the present ratio, there will be in 1890, 60,000,000 souls consuming perhaps 3,000,000,000 pounds of sugar per year, which would possibly be worth, at 7 cents per pound, $210,000,000. If our production at that time is only one-fifth of the consumption, or three times the present production, barring unforeseen circumstances, it would be only 600,000,000 pounds, leaving 2,400,000,000 pounds to be imported. This would be worth, at 7 cents per pound, $168,000,000, sufficient to give yearly employment, at $2 per diem, to 300,000 men—giving our own population the benefit of that home circulation of bullion.

Such are the possibilities of the beet sugar industry ten years hence. If we examine into the present consumption, importation and exportation of sugar, we find that we consume 1,601,200,417 pounds of foreign origin, and only 198,945,420 pounds of domestic production, representing a total of 1,800,145,837—say 38 pounds per capita. In 1880 we imported 1,829,302,684 pounds, and exported 10,498,202, the difference between imports and exports being 1,118,804,482 pounds—of a total value, including foreign customs, of $118,749,743. The home production, as compared with our population, is considerably less than it was before the war; for then, with a population of 30,000,000, it was 302,299,105 pounds, or 10 pounds per capita; while in 1880, with a population of 50,000,000, it is but 264,000,000 pounds, or 5.2 pounds per capita. This may, no doubt, seem paradoxical, but is true. The levees, which before the war protected the Louisiana plantations from the overflow of the Mississippi River, have in large part been destroyed. They could not be rebuilt for millions—perhaps hundreds of millions—of dollars. If we examine the sugar production of other Southern States than Louisiana, we will find that in South Carolina there has been an immense falling off in ten years, while in Mississippi it is now but nine-tenths of what it was twenty years ago. In 1860, the production in Louisiana was one-third of the total consumption in the United States; to day it is much less. Yet our gross consumption of foreign sugars has more than doubled in twenty years, being, in 1860, 660,777,673, and in 1880, 1,601,200,417 pounds. The consumption of home sugars has consequently decreased nearly 1,000,000,000 pounds.

Such are the extraordinary fluctuations of our most important commodity. Is it not imperative that we look before it is too late, to some other source than the cane for our sugar supply? Many of our sugar refiners and brokers, whose principal trade is carried on with Cuba, etc., offer considerable objection to home sugar production; but we fail to see where their interests would be in any way impaired, especially as within a few years slavery is to be abolished in Cuba. Are we not especially favored for home sugar production? Will the commerce existing between the United States and Cuba be as great after slavery has been abolished as it is to-day? If those foreign sugar-producing countries should no longer exist, we are convinced they would in no way diminish the interests of our refiners, who would then be interested in our home sugar production, which they are not, to any extent, to-day, being in many cases interested in sugar plantations outside of their mother country. Yet their direct refining business is practically less to-day than it was prior to the introduction of improved methods upon these sugar plantations.

The question of transportation from foreign shores and the placing of sugar upon the market at the most desirable time, is an item that should not be overlooked when this grand sugar question is discussed. With the sugar beet, for example, refined sugar might be produced from the root and placed upon the market at least one month earlier than either foreign or domestic cane sugar, thereby realizing the greatest profit at the season when sugars sell highest. The importance of having a minimum freight upon a merchandize is indisputable; yet in the Southern States the sugar cane can never fulfill this condition, and climatic conditions do not permit the maturing of the sugar cane in the South until at least one month later than the sugar beet in the North. In European countries, where these difficulties were realized, they sought some other plant than cane for supplying their home sugar. Many were resorted to in 1800; sorghum and maize were tried, but attempts at their utilization were soon abandoned. Yet, completely ignoring the experience of those older nations, we have, in consequence, spent hundreds of thousands of dollars in theorizing and in experiments with sorghum and corn stalks, yielding absolutely nothing. A recent pamphlet by Lewis S. Ware, on "The Various Sources of Sugar," reviewed the five thousand experiments made by our Agricultural Department at Washington, and showed that very little

over three per cent of sugar could be extracted from sorghum, and none from corn stalks. Is not this contemptible yield sufficient to condemn these alleged sugar-yielding plants? In all cases, the impurities in the sub-varieties of sugar cane prevent the crystallization of the saccharine juices. Hence the impossibility of extracting as sugar what sucrose they might possibly contain. Even if these insuperable difficulties were not to be contended with, we should condemn these plants, from which the cane sugar disappears within fifteen days after cutting, rendering storage impossible and economical manufacture impracticable. Again, the entire subject of sorghum and cornstalk sugar is yet in its laboratory stage, doing little toward solving the grand problem of manufacturing the sugar we consume. If we consider the maple tree, the idea of its utilization on a large scale is ridiculous. The same may be said of all other sources, the sweet potato, etc., from which, outside of the laboratory, nothing has been or can be obtained. But the sugar beet furnishes to day nearly one-half the sugar of the civilized world. Many assert that beet sugar making in this country is impossible, basing their assertion on past failures, without looking to their causes.

Efforts were made to introduce beet sugar making into the United States as early as 1829, a factory being established in Livingston County, and subsequently removed to Stevenson county, Ill. In 1869, the German Beet Sugar Company was organized at Chatsworth, Ill. In 1866, Fond du Lac, Wis., had a factory, which was moved to Alvarada, Cal. In 1870, the Santa Clara Valley Establishment, California, was organized, but this was moved to Black Hawk, Wis. In 1878, the Portland, Me., factory was started, but it has been divided up—South, East and West. In 1879, the factory at Franklin, Mass., was established, and we now hear talk of moving it to Schenectady, N. Y.

[*Conclusion Next Month.*]

Morality of Home Decoration.

Every improvement in the house is an improvement in morality. If it contain only one room, decency and modesty are still only dormant possibilities. So construct the house as to separate the parents and children, and an advance will be effected. Separate the boys from the girls, and this advance will be carried farther. Let the house that is continuously being improved be his own, and it becomes, of all that man can acquire, or that imagination can conceive his acquiring, the one possession that is most continuously suggestive and stimulative of morality. The efforts to acquire, to maintain, and to improve it are a daily, life-long schooling in morality. Industry, forethought, and self-denial are then the natural growths of his condition. And in the train of these virtues, and akin to them, comes the sense of the beautiful. The man so far advanced, and partly conscious of what it is that has advanced him, wishes to adorn what is his own, and which he loves dearly because it is so precious to him. He ornaments his doors and windows. He paints his walls and ceilings. He studies the form of his furniture and of his domestic utensils. And in this way is quickened within him the germ, also, of the fine arts.

The house, the home that is one's own, is as potent as it is simple and unfailing in working these humanizing effects. We see evidence of this in what remains to us of the domestic architecture of the middle ages, Men then bestowed much thought on the designing and decoration of their houses, because they were their own. Door posts and lintels were carved; ceilings were molded; windows were mullioned; walls were wainscoted. Here was universal training for design, invention, and execution. The fine arts school was then in every house. This is Nature's plan. That Nature's plan was not then suppressed by law accounts for the beauty of the parish churches, the abbeys, and the cathedrals of those times. The skill and sense of beauty they display had been called into being and widely disseminated by the designing and decoration of dwellings that belonged to those who lived in them.

Industrial Training in Girard College.

The experiment is about to be made of introducing industrial training into Girard College. The plan to be followed is that known as the Russian system, which has been adopted in its leading features by the Boston Institute of Technology, and which aims to teach the principal processes of the various trades, rather than the production of commercially valuable products.

The plan of familiarizing the people with the use of tools was attempted years ago, but for some reason it was shortly abandoned. The present prospect is very favorably thought of, as the following allusion to it in one of the local papers, which is a sample of many of like tenor, will indicate:

"It was Stephen Girard's purpose that the children should be apprenticed, on their leaving the college, to some trade. The break-down of the apprenticeship system has abrogated this part of his plan. For many years it has been found impossible to obtain such places for them; and, where they have been apprenticed, in compliance with his will, the arrangement in many cases has been more nominal than real. The new plan carries out the spirit of his bequest, although the method is different. The children will at least learn the use of their hands, as the first step to the production of useful work. Meanwhile, our grammar schools go on teaching the whole body of the city's children the industry of the clerk. Days, months and years are spent on lessons in mercantile arithmetic and writing; and then, at the end of all, we wonder why so many want places at the desk, and so few at the work-bench!"

Boiler Inspection Report for November, 1881.

The Hartford Steam Boiler Inspection and Insurance Company have just issued a partial summary of visits of inspection and examinations made of boilers during the month of November, 1881. The returns, so far as received, show 1,394 visits of inspection, and 2,823 boilers examined, 1,217 of which were internal inspections, and 348 others were subjected to hydrostatic pressure.

The number of defects found, so far as reported, foots up 1,479, of which number 352 were regarded as dangerous, as per the following detailed summary:

	Whole number.	Dangerous.
Furnaces out of shape	103	12
Fractures	176	101
Burned plates	97	28
Blistered plates	171	24
Cases of deposit of sediment	218	21
Cases of incrustation and scale	312	24
Cases of external corrosion	97	27
Cases of internal corrosion	69	17
Cases of internal grooving	14	8
Water-gauges defective	18	4
Blow-out defective	15	9
Safety-valves overloaded	15	8
Pressure gauges defective	101	17
Boilers without gauges	38	38
Cases of deficiency of water	3	1
Broken braces and stays	26	13
Necks leaking	5	
Seams leaking	1	
	1479	352

CARE OF ENGINES.—Never allow an engine to become dirty, as thorough cleaning requires no great amount of labor. An engine which has always been kept clean, protected from rust and not abused in any way, is worth, when second hand, very much more than another which has had little attention, but allowed to rust, and to take care of itself generally. A handsomely kept engine, with all its parts clean and in good order, furnishes stronger evidence of an engineer's capabilities, than a volume of written recommendations.

To Join the Ends of a Band Saw.

File the ends of the saw on opposite sides to form two wedge shaped ends, having a lap of say, from ¾ to 1½ in., according to width and thickness of plate; a thin narrow plate for light work, like ordinary scroll sawing, ¾ in.; a wide saw, say 4 or 5 in. in width, by No. 16, 17 or 18 gauge, or 1½-in. lap. When the two beveled sides are laid together, they must form a joint of the same thickness as the blade. Now make two pairs of tongs with heavy jaws, long enough to cover the width of the blade; have the jaws straight and shut closely; cut a notch in a piece of about 6 by 6 joist for wide saws and smaller for narrow saws; have the notch large enough and covered or plated inside, so that it will not be burned by the hot tongs; now clamp the saw on the joists, so that the laps will come over the notch; the joists should be say, 4 ft. in length, and mounted on legs like a saw-horse; now cover the lap with the muriate of zinc or borax water, placing a piece of very thin silver solder or fine spelter solder in the joint. If spelter be used it may be mixed with borax water and spread between the joints. (Silver solder however, is preferable to spelter.) Now heat one pair of tongs to a bright cherry red, scrape off all the scale, &c., between the jaws; now clamp the joint to the brazed, using the cold tongs to clamp the points of the hot tongs; hold them a sufficient length of time to melt the solder; have the other pair of tongs warmed to about the heat of a sad iron; now carefully draw the hot tongs off toward the back of the saw, having the back rest firmly against supports so that the saw cannot move edgewise; have another person follow up the hot tongs with those merely warmed; hold the grip with the warm tongs until the joints are fairly set, when nothing remains to be done more than to file off the surplus solder. The above process will be found much better than cooling off the joints with water, as it is liable to harden and crack the blade. The soldering and cooling tongs should be made heavy and strong. The cooling tongs should not be used entirely cold, as the sudden chilling will harden the plate. If the process be properly performed the saw will be of the same temper at the splices as at other parts.

American Steel Steamships.

A project, which, if put into execution, may be productive of the most important results to American commerce and industry, is said to be in contemplation by one of our leading and best known capitalists. The scheme is credited to Mr. Lorillard, and is said to contemplate the establishment of a line of American built steel steamships, exclusively for the first class passenger business between New York and the prominent European ports. Thus far nothing more than the bare fact that such a scheme is being mooted is definitely known, but those who should be in a position to know something of the plans of the projector, speak of it as being certain of accomplishment in the immediate future.

The carrying out of a plan of this kind would, no doubt, give a decided impetus to the ship-building industry of this country, which is urgently needed. The carrying trade of the United States is now to a great extent done in foreign built ships, chiefly of British build, and but a single line of steamships bearing the American flag plies the North Atlantic.

A NUMBER of Liverpool engineers and ship owners are about to experiment with changes in the construction of the marine boiler.

Latest Market Report of Building Materials.

NEW YORK PRICES.

—o—

LUMBER.

Pine very choice and extra dry, per M	$60 00 *a* 70 00
Pine, good	55 00 *a* 60 00
Pine, shipping box	21 00 *a* 22 50
Pine, common box	18 00 *a* 20 00
Pine, common box, ⅝	16 00 *a* 18 00
Pine, tally plank, 1¼, 10 inch, dressed each	— 44 *a* — 50
Pine, tally plank 1¼, 2d quality	— 35 *a* — 38
Pine, tally plank, 1¼, culls	— 28 *a* — 30
Pine, tally boards, dressed, good	— 30 *a* — 32
Pine, tally boards, dressed, common	— 25 *a* — 28
Pine, tally boards, culls, dressed	— 23 *a* — 25
Pine, strip boards, merchantable	— 18 *a* — 20
Pine, strip boards, clear	— 24 *a* — 26
Pine, strip plank, dressed, clear	— 33 *a* — 35
Spruce boards, dressed	— 25 *a* — 27
Spruce plank, 1¼-inch, dressed	— 28 *a* — 30
Spruce plank, 2 inch	— 43 *a* — 45
Spruce wall strips	— 15 *a* — 16
Spruce timber, per M	20 00 *a* 25 00
Hemlock boards, per M	17 00 *a* 18 00
Hemlock joist, 2½x4, each	— 16 *a* — 17
Hemlock joist, 3x4	— 18 *a* — 20
Hemlock joist, 4x6	— 40 *a* — 44
Ash, good, per M	55 00 *a* — —
Oak	60 00 *a* 65 00
Maple culls	25 00 *a* 30 00
Maple good	45 00 *a* 50 00
Chestnut	48 00 *a* 52 00
Cypress, 1, 1½, 2, and 2½-inch	35 00 *a* 40 00
Black walnut, good to choice	115 00 *a* 125 00
Black walnut, ⅝-inch	85 00 *a* 100 00
Black walnut, selected, and seasoned	150 00 *a* 175 00
Black walnut, counters, per ft	— 22 *a* — 28
Cherry, wide, per M	100 00 *a* 120 00
Cherry, ordinary	60 00 *a* 80 00
White wood, inch	45 00 *a* 50 00
White wood, ⅝-inch	35 00 *a* 40 00
White wood, ⅝ panels	45 00 *a* 50 00
Shingles, extra sawed pine, 18-inch	4 60 *a* 5 00
Shingles, clear sawed pine, 16-inch	3 75 *a* 4 00
Shingles, cypress, 24x6	18 00 *a* 20 00
Shingles, cypress, 20x6	10 00 *a* 12 00
Lath, Cargo rate	2 00 *a* — —
Yellow dressed pine flooring	30 00 *a* 40 00
Yellow pine girders	32 50 *a* 40 00
Locust posts, 8 feet, per inch	— 18 *a* — 20
Locust posts, 10 feet	— 24 *a* — 25
Locust posts, 12 feet	— 29 *a* — 34
Chestnut posts, per ft	— 3 *a* — 3½
Basswood per M	25 00 *a* 30 00

Cargo rates 10 per cent off.

BRICKS.

	Cargo.	Afloat.
Pale, per M.	4 25 — *a*	4 75
Up Rivers	— — *a*	— —
Jersey	— — *a*	8 00
Haverstraw Bay	8 50 — *a*	8 62½
" " choice	8 75 — *a*	9 00
Favorite Brands	— — *a*	— —
Hollow Fire-Clay Brick	9 00 — *a*	9 25

FRONTS.

Croton—Brown, per M.	11 00 *a* 12 00
" Dark	12 00 *a* 13 00
" Red	12 00 *a* 13 00
Philadelphia	30 00 *a* — —
Trenton	28 00 *a* 30 00
Baltimore	40 00 *a* — —
Clark's Glens Falls, White	30 00 *a* — —
" " Red Fronts	27 50 *a* — —
" " Molded Red and White	45 00 *a* 80 00

Yard prices 50 cents per M higher, or with delivery added $2 per M for hard and $3 per M for front brick. For delivery add $5 on Philadelphia, Trenton and Glens Falls and $6 on Baltimore brick.

IRON—PER TON.

Duty.—Bar, 1 to 1½c. per lb.; Railroad, 70c. per 100 lbs.; Boiler and Plate, 1½c. per lb.; Sheet, Band, Hoop, and Scroll, 1¾ to 1¾c. per lb.; Pig, $7 per ton; Polished Sheet, 3c. per lb. Galvanized, 2½c. per lb.; Scrap cast, $6 per ton; Scrap Wrought, $8 per ton—all less 10 per cent. No Bar Iron to pay a less duty than 35 per cent ad val.

Pig, Scotch—Coltness	27 50 *a* 28 00
" Glengarnock	26 50 *a* 27 00
" Eglinton	24 50 *a* 25 50
" American, No. 1	26 50 *a* 27 50
" American, No. 2	24 50 *a* 25 50
" American forge	23 00 *a* 24 00

LEAD—PER 100 POUNDS.

German	— — *a* — —
English, common	— — *a* — —
Spanish	5 75 *a* — —
Foreign, refined	— — *a* — —
Bar	6 50 *a* — —
Sheet	7 50 *a* — —
Pipe	— — *a* — —
Domestic	4 63 *a* — —

TIN PLATES.—Duty, 1 1-0 cents per pound.

I. C. charcoal, 10x14, per box	6 50 *a* 6 75
I. C. coke, 10x14	5 76 *a* 6 25
I. X. charcoal, 10x14	8 25 *a* 8 50
I. C. charcoal, 14x20	6 50 *a* 6 75
I. X. charcoal, 14x20	8 25 *a* 8 50
I. C. coke, 14x20	5 75 *a* 6 25
I. C. coke, terne, 14x20	5 25 *a* 5 37
I. C. charcoal, terne, 14x20	5 50 *a* 6 00

NAILS—PER KEG.

10d to 60d, common, fence and sheathing	3 30 *a* 3 40
8d and 9d, common	3 65 *a* — —
6d and 7d, common	3 90 *a* — —
4d and 5d, common	4 15 *a* — —
3d and 4d, light	4 95 *a* — —
3d, fine	5 65 *a* — —
2d, fine	5 65 *a* — —
Cut spikes, all sizes	3 65 *a* — —
Clinch nails, 1½ to 1¾ inch	5 65 *a* — —
do. 2 to 2½ inch	5 40 *a* — —
do. 2½ to 2¾ inch	5 15 *a* — —
do. 3 inch and longer	4 90 *a* — —

SOLDERS.

Half and half	— 16 *a* — —
Extra	— 15 *a* — 15¼
No. 1	— 13½ *a* — 13¾

ZINC.—Duty, sheet, per lb, 2½ cents.

Sheet (cask) per lb	— 7¾ *a* — 8
Sheet (open)	— 8½ *a* — 9

STONE.—Cargo Rates Delivered in New York.

Amherst Sandstone, No. 1, buff, in rough, pr. cub. ft.	1 00 *a* — —
do do No. 2	85 *a* — 95
Bedford Stone	1 25 *a* — —
Berlin Freestone, in rough	— 75 *a* 1 00
Berea Freestone, in rough	— 75 *a* 1 00
Brown Stone, Portland, Conn	1 00 *a* 1 35
Bay of Fundy Wood Point Brown Stone	1 60 *a* — —
do Mary Point Brown Stone	1 00 *a* — —
do do Olive Stone	1 00 *a* — —
Brown Stone, Belleville, N. J	1 00 *a* 1 35
Granite, rough	— 60 *a* 1 25
Canaan Marble	1 25 *a* 1 50
Sutherland Falls Marble	1 25 *a* 1 75
Dorchester, N. B., Stone, rough, per foot	1 00 *a* — —

PAINTS.

Carmine, American, per lb	5 00 *a* 5 25
Chalk, per 100 lbs	— 35 *a* — —
China Clay, per ton	18 00 *a* 20 00
Chrome yellow, dry, per pound	— 12½ *a* — 28
Lead, red American, per pound	— 6¾ *a* — 7
Lead, white American, pure, in oil	— 7½ *a* — 8
Lead, white American, pure, dry	— 6¾ *a* — 7
Lead, white English, pure, in oil	— 9 *a* — 10
Litharge	— 6¾ *a* — 7
Ochre, Fr., dry, per 100 lbs	1 50 *a* — —
Ochre, ground in oil, per lb	— 6 *a* — 15
Ochre, Vermont, per 100 lbs	— 75 *a* 1 00
Orange Mineral, English	— 9 *a* — 10
Paris White, American	— 1¾ *a* — 1¾
Paris White, English, prime	— 2 *a* — 2¼
Paris Green	— 15 *a* — 28
Plumbago paint, patent, per lb	— — *a* — 25
Putty, per lb	— 2 *a* — 2½
Spanish Brown, dry, per lb	— 1½ *a* — 1¾
Spanish Brown, ground in oil, per lb	— 8 *a* — 9
Venetian red, per cwt	1 75 *a* 2 00
Vermilion, Chinese, per lb	— 85 *a* — 90
Vermilion, Trieste	— 70 *a* — 75
Vermilion, quicksilver, bags	— 50 *a* — 52½
Vermilion, American, common	— 15 *a* — 18
Whiting, per 100 lbs	— 60 *a* — 80
Zinc, white American, dry, No. 1	— 5 *a* — 7¾
Zinc, white American, No. 1, in oil	— 8 *a* — 10
Zinc, white French, dry, (Red Seal,)	— 7 *a* — 8
Zinc, white French, in oil	— 10 *a* — 10½

VARNISHES—PER GALLON.

American Wearing Body	3 50 *a* 4 00
Coach Body	2 35 *a* 3 50
do do	1 80 *a* 2 00
Furniture	1 25 *a* 2 50
Black Asphaltum	1 00 *a* 1 50
Brown Japan	1 00 *a* 1 20
Liquid Paint Dryer	1 35 *a* 1 75
Harness, (black)	3 00 *a* 4 50
Shellac, Spirits	3 00 *a* 3 50

CEMENT—PER BARREL.

Portland (imported)	2 75 *a* 3 50
Portland (American)	2 40 *a* 2 65
Portland (Lafarge)	3 40 *a* 3 65
Lime of Teil	2 30 *a* 2 50
Lime of Teil, per ton	15 00 *a* 18 00
Roman	2 75 *a* 3 40
Keene's & Martin's, coarse	6 00 *a* 6 50
" fine	10 50 *a* 10 75
Rosendale	1 25 *a* 1 40

HAIR.

Cattle, per bushel of 7 lbs	— 16 *a* — —
Goat. " "	— 21 *a* — —

SLATE.

Purple, roofing slate, per square	$6 00 *a* 7 00
Green slate	6 00 *a* 7 00
Red slate	13 00 *a* — —
Black slate, Pennsylvania, (at Jersey City)	4 75 *a* 5 25
Slate tiles, 1¼-inch, rubbed, per square foot	20 *a* — 25

PLASTER PARIS.

Duty.—20 per cent ad. val. on calcined; lump free.

Calcined, ordinary city, per bbl	1 30 *a* 1 40
Calcined, city casting	1 55 *a* 1 65
Calcined, city superfine	1 75 *a* 2 00

LIME—PER BARREL.

State, common	1 25 *a* — —
" finishing	1 40 *a* — —
Rockland, common cargo rate	1 25 *a* — —
" finishing	1 40 *a* — —
Ground	1 15 *a* 1 25

Add 25 cents to above figures for yard rates.

FOREIGN WOODS.

MAHOGANY.

St. Domingo, crotches, ordinary to good, per ft	— 15 *a* — 28
St. Domingo, crotches, fine	— 20 *a* — 30
St. Domingo, logs, small	— 5 *a* — 38
St. Domingo, logs, large	— 8½ *a* — 14
Frontera, Mexican, large	— 12 *a* — 15
Frontera, Mexican, small	— 6 *a* — 8
Other Mexican	— 6 *a* — 12½
Honduras	— 6 *a* — 12½

ROSEWOOD.

Rio Janeiro, ordinary to good, per lb	— 2½ *a* — 4½
Rio Janeiro, good to fine	— 5 *a* — 8
Honduras	— 6 *a* — 12½
Satin Wood, per foot	— 15 *a* — 75
Tulipwood, per lb	— 6 *a* — 7
Lignumvitæ, large, per ton	30 00 *a* 50 00
Lignumvitæ, other sizes	10 00 *a* 25 00

CEDAR.

Cuba and Mexican, small, per super. ft	6 *a* — 7½
Cuba and Mexican, medium	8 *a* — 9½
Cuba and Mexican, large	10 *a* - 11
Florida, per cubic foot	40 *a* - 75

RUBBER ROOFING.

Complete materials for new roof, per square	3 50 *a* — —

DEADENING AND ROOFING MATERIAL.

Mineral wood for Roofs and deadening, per lb	— 1¼ *a* — 1½

LABOR.

Ordinary, per day	2 00 *a* 2 50
Masons, do	3 50 *a* 4 00
Plasterers, do	4 00 *a* — —
Carpenters do	4 00 *a* — —
Plumbers, do	4 00 *a* 4 50
Painters, do	3 00 *a* 3 50
Stone-Cutters, do	3 00 *a* 3 50

REVIEW OF THE MARKETS.—In the lumber market during the past month trade has continued in a generally favorable condition for the selling interest, and pretty much all of the reports have been in a cheerful, hopeful strain. At this season of the year business is always liable to sudden and unexpected interruptions of more or less duration, owing to the vagaries of the weather; but it is considered that this has already been fully neutralized by the unusually liberal distribution of the open winter and remaining stocks, or prospective additions for some little time to come are good property, but more especially of course the better assortments of quality.

In the brick market scarcely any change of a positive character has taken place in the situation of affairs on the market for common hards since our last, except possibly that the facilities for reaching supplies from the North River have been somewhat reduced by the condition of the weather. The demand, however, has not been such as to require a quantity greater than available, and buyers unwilling to handle the large parcels could secure smaller cargoes by taking Long Island at about the same rates as the holders of river stock were asking. Actual consumption has been only fair and quite irregular, but the selling interest appears rather indifferent over any lapse in the demand, as there is no likelihood of any heavy accumulation of supplies, and the belief in a full spring consumption continues with no contradiction, except the old theory that higher cost will lead to caution among buyers, even possibly to the extent of leading them to postpone work.

In the lime market demand, all things considered, was fair, and some arrivals, together with cargoes afloat, received attention on the basis of former cost, and prices remain steady. There was, however, no indication of any tendency to buoyancy, and for the present sellers appear content to hold the advantage as it stands.

In the hardware market the movement of supplies on domestic account has been full and growing, and, with the foreign call keeping up well, the market has quite an active appearance throughout. Indeed, the position has seemed to realize all the most hopeful anticipations, and dealers, without exception, speak in a cheerful, confident tone. Supplies are only fair, the drafts made since the opening of the year having already cut down accumulations, and left many manufacturers laboring under difficulties in the effort to keep up with the call made upon them.

In the metal markets manufactured iron has continued in very good demand, especially finished stock, and the tone of the market has been strong at full former rates. Scotch pig has been very quiet, and to a considerable extent nominal. Stocks here are rather moderate, and would probably be difficult to reach except at full former rates, but in view of depressed markets abroad buyers take hold only under the pressure of the most urgent necessity, and the investment in parcels to arrive has ceased. American pig presents little or no change of a positive character. Present demand continues moderate, but the offering of supplies is correspondingly small, and with producers reporting contracts in hand to keep them busy for weeks to come, there is little danger that any necessity for shading on cost will arise. Domestic pig lead has undergone but little change, prices standing much the same as before and fairly steady, but the demand without much animation. Pig tin has not been very plenty in the hands of either dealers or speculators, and on a favorable construction of foreign advices they have carried stocks with confidence, though the demand has rather lacked stimulating animation. Tin plates have been fairly active and with a generally steady tone to the market.

In the paint market business, while at times somewhat irregular, has been in a general way gradually increasing, and the market has secured a corresponding degree of firmness.

Home Department.

The Jackson Heat-Saving and Ventilating Grate.

It is a fact noticed by all who have made a study of the statistics of the sanitary condition of the American people, that the last half century has witnessed a startling increase in the number and kinds of diseases that have their origin, either immediate or remote, in the breathing of foul air—namely, that which is contaminated by the breath of human beings and by exhalations from their bodies, or is poisoned by emanations from decomposing matter that, in gaseous form, enter our dwellings, and remain there in consequence of defective ventilation.

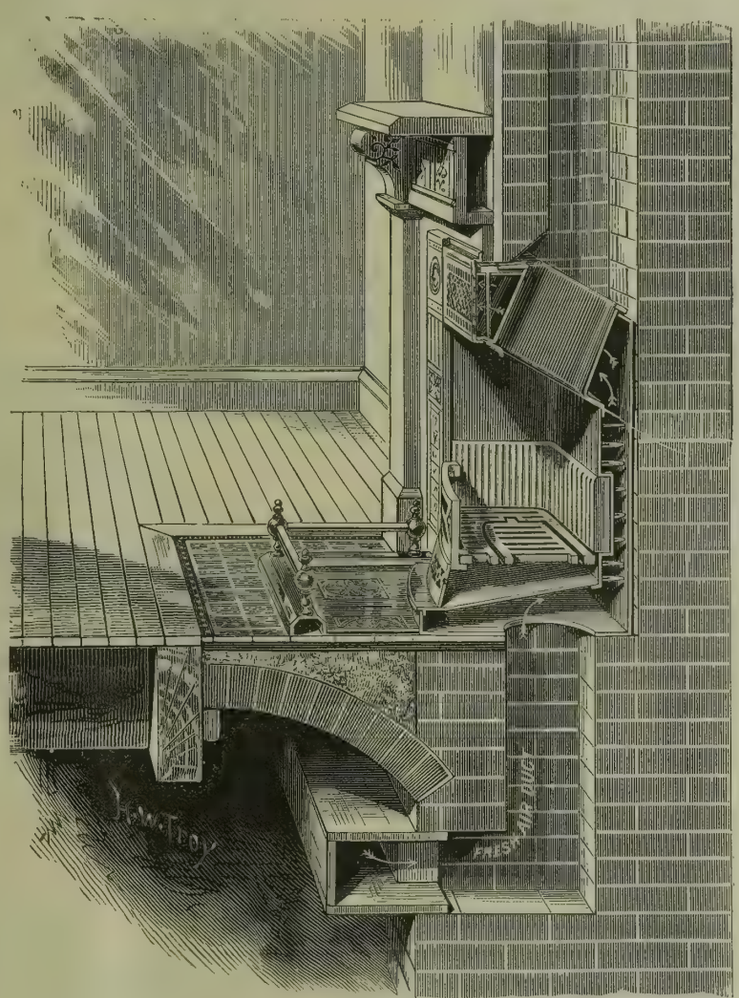
With the increase of wealth and general culture, great progress has been made in protecting dwellings against cold and wind and storm, by making the walls weather-proof, the windows and doors impassable avenues to the winter blasts, and the fire-places sealed to the escape of heat generated within the walls. Elaborate and costly decorations adorn the walls, the floors and ceilings are beautiful to look upon; but in these artistic and costly homes "the blighting, withering curse of foul air is found," and the shadow of death rests over them all. In the struggle to keep the cold air out, the necessity for admitting an abundance of pure warm air into the dwelling is neglected, and the story of this neglect is written upon the pale faces of the children and imprinted upon the weakened fabric of their lives.

The effect of a temperature of the air in our houses a few degrees below that of the body, is almost immediately noticeable in a feeling of discomfort, and we soon seek to remedy the fault by perfecting the method of heating the rooms, or by preventing the entrance of cold air in them. But the effects of breathing a vitiated atmosphere (the impure condition of which in our dwellings is probably either brought about, or is maintained, by the very means employed for increasing the temperature) are not immediately noticeable, and though so direful in their character, are overlooked and neglected on that account. It is for this reason that any system of ventilation that depends upon the agency of the inmates of our dwellings for its regulation or its operation, is defective, and to a great extent valueless. This is the great fault of the prevalent system of ventilating by means of registers for the admission of pure cold air near the floor and for the emission of the warm and supposed impure air near the ceiling. Even if these work as they are theoretically supposed to, they will generally be found closed in cold weather, and their office thus entirely destroyed. But even where due diligence is taken to keep such ventilating registers always open, they generally fail to work satisfactorily; first, because the impurities of the atmosphere are not confined to the higher levels of the room near the exit registers; second, because when they operate, they carry off a large amount of *pure* heated air that is needed for comfort in the rooms; and thirdly, because they frequently will not work at all, since the exit registers do not communicate with heated flues.

It is a truth that is rapidly becoming recognized by householders, that the heating apparatus employed in the dwelling should also perform the office of a ventilator for it. The chimney has been aptly called the lungs of a house, and where its office is unobstructed, it may prove a very efficient ventilator. Dr. Hartshorne, in the Health Primer entitled "Our Homes," says: "Every room in the house intended to be occupied, should have in it an open fire-place. Especially is it important for an open fire-place to be in every sleeping-chamber. For a sick person, the difference between a wood fire on the hearth and the usual heated air or coal stove in the room, is immense. It may in critical cases make the turning point between death and recovery."

There are, however, two prominent objections to the open fire-place, and to the ordinary form of fire-place grate: First, though they are excellent agencies for removing the air from the lower levels of the room (removing, as they frequently do, the whole air contents of the room once every fifteen or twenty minutes), they provide no means for supplying the vacuum thus produced, and thus they cause drafts of cold air about the windows and of impure air from the surrounding rooms. Second, they supply to the rooms in which they are placed but a very small fraction of the whole heat product of the fuel. From the careful tests of Gen. Morin, the deduction is made "that of the heat generated by the fuel in an ordinary fire-place, about one-eighth only is utilized in the room."

The Jackson heat-saving and ventilating fire-place largely remedies both these defects. As will be seen by a reference to the accompanying engraving, fresh air from immediately out-doors is taken into a shaft directly under the grate, and enters a chamber beneath the fire, where it is partially heated, and thence passes into chambers surrounding the back and sides of the fire-place, and it conserves in these the heat that is usually lost in the brick-work of the fire-place. Passing thence in the direction of the arrows, this now heated current circulates about the tubular flues, five in number (one of which is distinctly shown in the cut), which convey the smoke to the chimney above. Finally, this heated air, which, it will be observed, is pure air from outside the building, enters the room through the open frieze of the grate-frame, and from its levity ascends in a current to the ceiling. A double office is thus fulfilled. A very large part of the heat usually lost in the fire-place is conserved and added to that directly radiated from the fire, making the grate equal in heating power to over three ordinary grates of the same size; and an amount of pure, warm air equal to that taken from the room by the exhaust of the chimney, enters from the heat-saving chambers, and thus all drafts from the windows and doors are prevented. A continually augmented volume of pure warm air, occupying the higher levels of the room, and a continual draft being made by the fire-place from the colder, impure air from the lower levels, keeps up a constant atmospheric circulation, and thus automatically the room is thoroughly ventilated.



THE JACKSON HEAT-SAVING AND VENTILATING GRATE.

The makers of this fire-place, Messrs. Edwin A. Jackson & Bro., of 315 East 28th street, New York, have these grates in use in nearly every State in the Union, where they are heating with them large rooms that ordinary grates would utterly fail to heat, and at the same time are most efficiently ventilating them. Reports were given from Michigan during the intensely cold weather of last winter, that one of these grates was thoroughly heating and ventilating rooms equal in size to one 20 feet wide by 25 feet long.

These grates, by special adaptation, are arranged for setting in exterior or interior walls, and on any floor, also for the use of ash-pits where desired.

Table Manners.

With regard to behavior at the table, a contributor to the New York *Evening Post* gives some excellent hints, of which the following are the chief:

It is impossible to estimate properly the immense influence which is exerted upon a household by the atmosphere of the family table. A neat, well-ordered table is in itself a lesson to the children. To the inviting table, where there should be always something attractive, however simple the meal may be, most children will come prepared to behave properly.

It really is worth while, and, when philosophically considered, is a matter of great importance, to lay aside as far as possible all thoughts of the hard work done before and to be done after a meal, and to allow no vexatious questions to be discussed at this time. The habit of brooding over our work, and exhausting ourselves by going all over it in our minds, is one to be studiously avoided. There is nothing which takes from one's energy more than this, and it is a frequent cause of insanity. Everybody knows that food digests better when eaten in agreeable company. It was something more than a pleasantry which made a friend remark that he could not have his wife and child pass the summer vacation away from him, as it gave him dyspepsia. The poor child who comes to grief at the table, and is sent away from it with his dinner half eaten, and who suffers the whole afternoon with an undigested lump of feed in his stomach, is to be pitied.

It follows, then, that pleasant surprises in the way of preparing favorite dishes, that good taste and much painstaking in arranging all the appointments of the table and dining-room, rise above a mere ministering to the animal existence, and effect the fine issues of life.

"When Should a Child begin School?"

Dr. William Pepper writes as follows in the first number of *Our Continent:*

"I fear many children are sent to school merely to keep them out of mischief; and to accomplish this purpose they may probably begin very early indeed. But nothing can well be more unfair and injudicious than to subject a child to irksome confinement and premature study for the sake of convenience or to supplement defective methods of home training. It is clear also that no fixed age can be adopted as the proper one for sending all children to school. There are people who with rash consistency light fires in their houses on the 1st of November, and put by their overcoats on the 15th of April, though Vennor or some more reliable prophet should foretell a glowing Indian summer or a succession of Arctic waves late into May. So, too, there are many parents who seem to put their children to school when the predetermined birthday comes, without the least consideration of the mental and physical development of the subject of their experiment. The plain truth is that each child should begin school when he is fit for school—that is, when he is physically strong enough to bear the confinement and the mental effort. Few appreciate the strain that even two or three hours attendance daily, and the effort to master two or three simple little lessons, exert on the sensitive organization of young children. Their brain and nerves are exquisitely delicate, and it is a period of such rapid growth that the power of nutrition is taxed in supplying material for the formation of perfect tissue. The thousand objects that daily attract the keen observation of the child, the new words and phrases, the nursery rhymes and tales and games, afford stimulus enough to quicken the development of the mental faculties. Abundant outdoor exercise, leisurely meal-times and long hours of unbroken sleep are absolutely necessary to promote appetite, digestion, and nutrition. Many cases of indigestion, of nervousness, of general weakness, even of apparent backwardness of intellect, are due to insufficient outdoor exercise and premature study. Children vary greatly as to the age at which they can begin to bear restraint on the freedom of their movements, and strain upon their attention and memory. Mill may have begun Greek at four, but Hunter did not know his alphabet at seven. The one thing certain is that any study or any attendance at school before the child can bear it without effort or fatigue is not only useless but hurtful, and will surely retard the education and lessen the future vigor and capacity of mind."

Gardner & Co.'s Veneer Seats, Chairs, Etc.

The veneer seats, chairs and the like, manufactured by the above named firm, and which have on several previous occasions been favorably noticed in the columns of this journal, acquire special interest from the fact that has lately been brought to our notice that the firm engaged in their manufacture has recently secured the reissue of letters-patent covering the essential features of the veneer seats in a much broader and more comprehensive manner than in the earlier patents of the firm.

The three-ply veneer seats, as the manufacturers designate them, and which they adapt to chairs, settees, car and steamboat seats, etc., are made by glueing veneers together so that the fiber of each layer crosses the other at right angles. These veneer seats are neatly perforated and shaped to fit all styles of chairs, rockers, and settees adapted to cane. By this method, the makers produce a highly ornamental and comfortable seat at about the same cost as for cane, which can be nailed on to a seat by any one with sufficient skill to wield a hammer, and which, when once properly in place, will wear indefinitely. These veneer seats have all the merits of cane, with none of the objectionable features of the latter.

For illustrations of these popular goods we refer our readers to the back volumes of this journal, in which a number of styles are shown. Our special purpose, however, in inviting the subject again to the notice of our readers, is to present the claims advanced by Messrs. Gardner & Co., to prove their right to priority of invention, which has been ignored by others. This claim appears to be fully established and borne out by the contents of the specification of the reissued patent granted to the firm on February 24th 1880. This reissue contains the following claims, which appear to cover the ground so fully as to preclude difference of opinion on the subject. The claims are as follows: First, as a new article of manufacture, a chair-seat formed of laminæ of wood, with the grain crossing, glued together, and concaved on the upper surface and convex on the lower surface, adapted to a chair-frame, substantially as set forth. Second, a chair-seat, made of laminæ of wood glued together, with the grains in one layer crossing those of the next, concave on the upper surface, convex on the lower surface, and perforated, as a new article of manufacture, substantially as set forth.

The manufacturers referred to herein now affirm, and their affirmation is supported by the opinion of Messrs. Gifford & Gifford, the oldest and most experienced patent lawyers in New York, that the reissued patent establishes the fact of the priority in this useful improvement to the manufacturers in question beyond dispute. Should these statements prove to be correct, as we have no reason to doubt they will be, the circumstance will not only be highly creditable to Messrs. Gardner & Co., but will likewise assure them substantial pecuniary reward.

The statements embodied in the forgoing notice have been brought to our attention in a communication by Messrs. Gardner & Co., 183 Canal street, New York, dated February, 1st, 1882.

Pear Wood.—The timber of the pear-tree is of a yellow color. Gerard says the timber of the wild pear is very firm and solid, and good to be cut into molds. The plates for his "Herbal" were cut out of this wood, as were, says he, breastplates for English gentlewomen. At the present day it is much used by turners and pattern makers; the blocks with which the designs for floor cloths are painted are made from pearwood. When dyed black it can scarcely be distinguished from ebony. Handles for carpenters' tools, measuring rules, &c., are made from this wood. The wood of the pear makes excellent fuel, giving out an intense heat with a bright flame.

Miscellaneous and Advertising.

Those wishing an engine of from 3 to 8½ horse-power, will find the Bookwalter, manufactured by James Leffel & Co., of Springfield, O., to meet their wants.

An excellent motor, and one that is perfectly safe and reliable, is the Sherrill hot-air engine, manufactured by the Sherrill Roper Air Engine Co., of 91 and 93 Washington street, New York.

"How to Keep Boilers Clean," and other valuable information for steam users and engineers. Book of 64 pages. Published by James F. Hotchkiss, 84 John street, New York. Mailed free to any address.

John G. Avery, of Spencer, Mass., has produced in his anti-friction bearings a most ingenious and valuable improvement. They are adapted for shafting, carriage axles and all machinery, and save 50 per cent in power.

House owners, in making their spring repairs, should examine a sample of the rubber roofing made by the Indiana Paint and Roofing Co., of Indianapolis, Ind., before purchasing other kinds. This roofing weighs but 60 pounds to 100 square feet, and is very cheap. It can be laid by any one, and is very durable.

Bentel, Margedant & Co., of Hamilton, O., manufacture a very extensive line of wood-working machinery, comprising their universal wook-workers, planing, matching, molding, band and scroll sawing machines, and carriage, wagon and wheel machinery.

"More than 13,000 sold" tells the story of the popularity of the Blake pumps. The manufacturers, the George F. Blake Manufacturing Co., of this city and Boston, have constantly large orders in hand, which, by reason of their immense facilities, they are enabled to fill promptly.

The glass dome skylights of S. J. Pardessus, of 9 and 11 Park Place, New York, are being introduced very extensively on both public and private buildings. These skylights, with Mr. Pardessus's valuable ventilating contrivance, leave nothing to be desired in the way of perfect light and pure air.

S. C. Forsaith & Co., of Manchester, N. H., offer 1,977 machines, both new and second-hand, for sale at reasonable prices. These machines comprise blacksmith tools, wood-working machinery, portable engines, upright and horizontal stationary engines, boilers, milling machinery, and in fact machinery for every manufacturing purpose.

Designs for Small Chapels.

The Manufacturer and Builder has now and then offered to its readers suggestions for buildings other than dwellings, and this month gives a number of illustrations of small chapels that have been erected in different parts of the country. The cost of these chapels has been as here given, and they can be erected for about this sum again, the possible variation depending upon location.

No. 1 will seat 150 persons, and has an extension for the pulpit-recess with a room on each side, one for the pastor and the other that may be used as a library for the Sunday school.

No. 2 will seat about the same number of persons, but the finish is plainer and the extension is omitted.

No. 3 has a room in connection with the main room that is used for prayer-meetings, meetings in relation to parish affairs, etc, and is so arranged that it can be quickly and easily thrown open to the main-room when greater space is needed on special occasions, as anniversaries, etc.

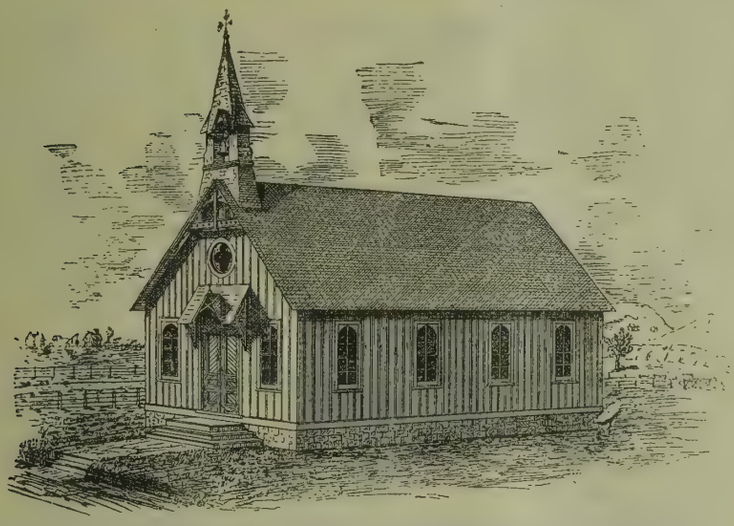
No. 4 has a seating capacity of 200, and will cost, as stated, about $2,200, First built in an Iowa town, it was afterward built in a rapidly growing city in Dakota, modified somewhat to meet the requirements of the congregation.

No. 5 was designed for and built by the Presbyterian church at Elmer, N. J. It has sittings for 200, with a lecture-room in connection with the auditorium capable of seating 70. There are two entrances, so placed that they serve both for main room and lecture room, and may be used for entrance to one room without opening the other. The lecture room can at times, when extra room in the main church is wanted, be thrown into it without any difficulty.

As shown, these designs are all for frame buildings, but the same general plans can be used, if necessary, for stone. They are the work of Messrs. Smith & Howe, architects, 7 Warren street, New York, and have been selected from a large number as most likely to help those of our readers who may, now that spring and the building season are approaching, be interested in the matter of a new church edifice of moderate cost.

Franklin Institute Secretaryship.—At the annual meeting of the Franklin Institute of Philadelphia, held January 18th, Dr. William H. Wahl, the editor of this journal, was elected secretary.

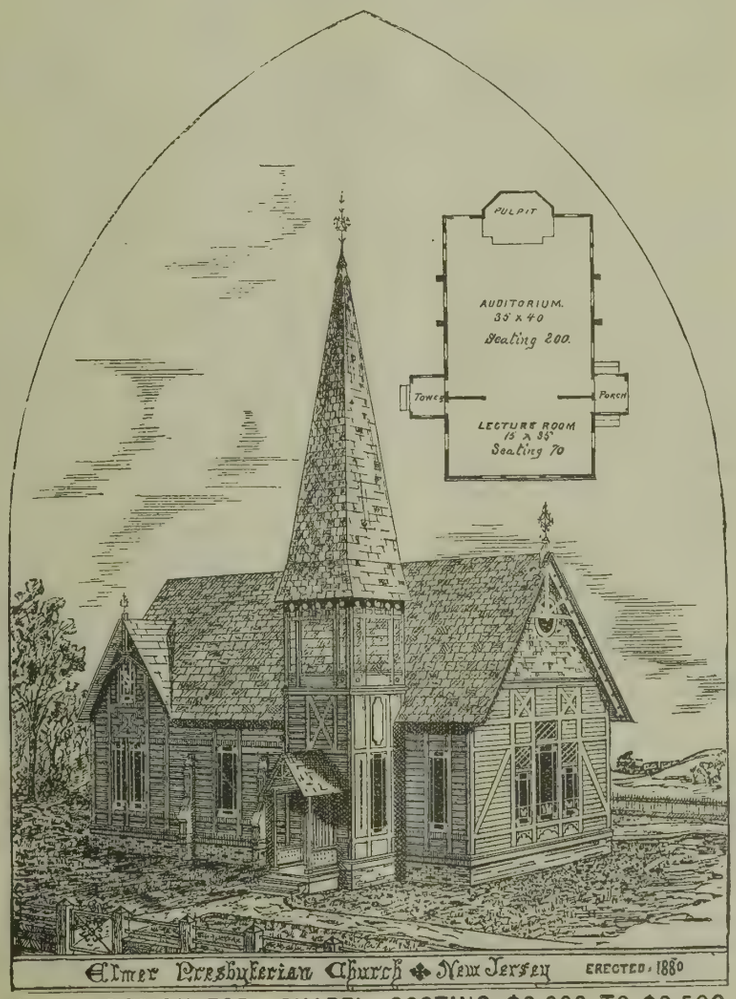
No. 1.—DESIGN FOR CHAPEL, COSTING $1,500.



No. 2.—DESIGN FOR CHAPEL, COSTING $900 TO $1,000.

No. 3.—DESIGN FOR CHAPEL, COSTING $1,800.

No. 4.—DESIGN FOR CHAPEL, COSTING $2,200.



No. 5.—DESIGN FOR CHAPEL, COSTING $3,000 TO $3,500.

What Becomes of it All?

Since the period of authentic history, in all nations and amongst all people, gold has been considered the most precious of all metals. It has purchased kingdoms and ransomed kings. It has built up thrones and overlaid them with its glittering sheen until its reflected light has dazzled the eyes of nations to the crimes and follies of those who sat upon these thrones, and taught all mankind to covet that which possesses so much reflective glory. And yet the average life of an English gold sovereign is only about eighteen years! Within that time the coin loses by attrition or abrasion three-quarters of a grain in weight and then ceases to be a legal tender. As a coin of that value it has ended its mission. The profile of the sovereign, ruling Dei Gratia, has lost its grace and potency to carry this coin through the marts of trade. And yet like many extinct and worthless politicians, and worse than faded beauties of fashion, it still continues to pass current upon its former reputation, for we are told that of the £100,000,000 of British gold coinage extant, more than forty per cent or $200,000,000, is worn down below the legal weight.

Gold is one of the most durable of metals in its power to resist atmospheric agencies, and yet what has become of the gold of early historic or pre-historic ages? For through all time it has been amongst mankind the metal of metals, the very God of man's worship. Where is the gold of Ophir and of Parvaim which overlaid the beams and posts and doors and the walls of Solomon's Temple, and the golden nails, and lamps, and tongs, and spoons, and censers, and the candlesticks, and the hundred basins of pure gold, and all that the curious Queen of Sheba brought, which was an hundred and twenty talents? Solomon's was really the "golden age" in metals as well as in wisdom; for the weight of gold that came to him in one year was six hundred and three score and six talents, besides that which chapmen and merchants brought, and all the kings of Arabia and the governors of the country sent in by way of tribute or free gifts.

Is any of the precious dross which the philosophers hold in scorn and we worldlings eagerly clutch at, still extant? Are there any few grains of the golden calf yet seeking worship and idolatry from among living men and women? Perhaps. A few pennyweights of this old gold may even now deck out the Queen of Mozambique or the multitudinous wife of the gentle King of Ashantee, or glitter upon throats or arms in Fifth avenue, or tempt the staring wayfarer from broker's windows, or lend a deceptive value to the "rolled plate" and stem-winders that make this age so happy in the abundance of cheap jewelry. Who knows?

It is a general conjecture or estimate of political economists, that at the close of the fifteenth century, there was in the world only gold to the amount of about $60,000,000—that is of gold reduced to possession and use. This, we have from the authority of M. de Lavieleye in the *Revue des Deux Mondes*, and this all told would have fallen short of the vast store which Solomon had gathered together before Sheba came to see him. But from that date (1500), the gold fields of the world commenced giving up their treasures, and during the next three centuries and a half $2,800,000,000 or thereabouts—a few dollars more or less—are supposed to have been produced. What the last thirty years have done in swelling the grand golden total is almost beyond calculation. According to M. Ernest Seyd, a celebrated financial writer, there is in this western world alone $3,600,000,000 in gold coin and bullion. The estimated annual gold production of the world is put at $142,000,000. The loss by attrition or abrasion of coin in circulation is put at about one third of one per cent per annum. In other uses it is far greater. At the given ratio of "consumption" a certain bulk would thus be supposed to disappear from the eager grasp of mankind in about three hundred years and "leave not a wrack behind."

It were idle, therefore, to try and trace any of the golden stores of Solomon or of Ophir or of Sheba's queen among the ingots of the mint or the gorgeous ornaments of Tiffany or Duhme.

Motive Power at Present and in the Future.

The increasing development of manufacturing industries and the increasing transportation needed for purposes of foreign and domestic commerce demand increased motive power, and lead to the consideration of the question whether our present resources are ample for all time, or will have to be supplemented by some yet undiscovered source of energy. Water-power, the cheapest of all, exists in enormous amount along the streams of the Alleghany range from Maine to Alabama, and is, of course, secure from any considerable diminution, but cannot be made available for more than a fraction of the immense power ultimately needed. Our forests are not destined to survive long the heavy demands already made upon them. We are compelled for the immediate future to place our main dependence upon coal—anthracite and bituminous—of which our supplies are believed to be manifoldly greater than those of all other nations combined. The latest census bulletin estimates the total net production after 1880 at but 4,009,640,000 tons, and the output of that year, it adds, can be maintained but 146 years. The area of the bituminous fields of the United States is 200,000 square miles, containing 600,000,000,000 tons, or enough to last twelve hundred years if the annual consumption were limited to 50,000,000 tons. A coal famine need not be dreaded as a pressing danger in this country, if we are content to use the bituminous variety. Long, however, before our supplies of fuel are consumed it is more than probable that other sources of power will be discovered and perfected. It is already easy to convert the power of a waterfall into electricity and that into heat or light. Not only so, but the properties of electricity are such that we may convey it hundreds of miles and apply it, by means of suitable machinery, to the performance of all kinds of work. It has already been applied in Paris to the propulsion of machinery for manufacturing delicate mathematical instruments, to the propulsion of cars, boats, velocipedes, &c. There is no inherent difficulty in utilizing the vast power now wasted on nearly all rivers by means of water-wheels which will be used to generate electricity, which in turn may be carried on radiating lines of wire to all parts of the adjacent country, to be reconverted, when needed, into mechanical power for manufacturing or railroad purposes. And so of every creek and streamlet, and even the wasted energy of the tides. It has been the world's experience that for every anticipated need of the character here discussed some remedy is in time supplied by the widening ingenuity of man.

Railroad Construction in the U. S. for 1881.

The Chicago *Railway Age* has submitted its statistics of railroad construction in the United States during 1881 which show that the track has been laid on 258 different lines, aggregating 8,242 miles—the largest mileage ever constructed in any one year—that for 1880 having been 7,174 miles, which was greater than that of any previous year, except 1871, when the total reached 7,379 miles. Of the forty-two States and Territories in which the work of railway-building was prosecuted in 1881, Texas takes the lead, with 1411 miles; Iowa follows with nearly 500, while Maryland is credited with only 25 miles of new railroad, Georgia with 54½ miles, Alabama with 14, Arkansas with 109, Florida with 103, Kentucky with 143½, Louisiana with 236, Missouri with 229, Mississippi with 68, North Carolina with 149, South Carolina with 67, Tennessee with 37, Virginia with 273, and Dakota and Ohio with between 400 and 500 miles each. Of the total mileage, 1490 miles, or about 14 per cent were narrow gauge lines. With the exception of Texas, through which the Southern Pacific has been pushing its way, the Southern States scarcely make the showing that was expected.

New Publications.

Modern Architectural Designs and Details. William T. Comstock, 194 Broadway, New York.

We have noticed this admirable work from time to time as successive numbers of it came to hand, and now that it is before us complete, we can only reiterate our previously expressed opinion that it is one of the most useful and reliable contributions to architectural literature that has lately been made, and cordially renew our recommendation of it to those of our readers who are interested in the subject. The following brief summary will suffice to convey an idea of the ground it covers. It forms a quarto volume, handsomely bound in cloth, and contains 80 finely lithographed plates, with explanatory text in English and German, giving perspective views, designs, plans, details, etc., of a great variety of buildings in the Elizabethan, Queen Anne and other popular modernized styles; exterior and interior details of dwellings, stores, offices, etc.; also a number of designs of low-priced cottages in the various popular styles, adapted to the requirements of seaside and summer resorts, and suburban and country places, comprising drawings by prominent architects of New York, Boston and other localities, as well as other designs prepared expressly for this work. All elevations, plans and details are drawn to scale.

The Sugar Beet Industry. A Paper read before the National Tariff Convention, New York, November 30, 1881. By Lewis S. Ware and Robert Grimshaw, Philadelphia.

This paper, issued by its authors in the form of a neat pamphlet of 14 pages, is an able and forcible presentation of the vast industrial importance of the beet sugar industry. It contains a brief historical statement of the growth and development of the industry in Europe, and an earnest plea for the domestication of the industry in the United States. It gives an account of the several attempts heretofore made in this direction, points out the reasons that contributed to the failures that have been made, and tells how in the opinion of the authors these failures may be avoided in the future.

The authors have identified themselves with the introduction of this industry in the United States, and are doing valuable pioneer work in agitating the subject and in seeking to create a general interest in the beet sugar industry.

Pocket-Book of Useful Formulæ and Memoranda for Civil and Mechanical Engineers. By Guilford L. Molesworth. Second American from the tenth London edition. Philadelphia: Henry Carey Baird & Co., Industrial Publishers. Price, $1.

Molesworth's pocket-book of Engineering formulæ has been known for years as a standard and reliable book of handy reference, and its usefulness and popularity are well confirmed by the fact that it has gone through ten editions abroad since its first appearance in 1862, and besides two editions in this country. The work, however, is too well known among the engineering profession to require detailed allusion to its merits at our hands. It will suffice to say that the publishers above named have issued a new edition in convenient pocket-book form, at the very low price of one dollar, which should command for it an extensive sale.

Chapels Erected from the Designs of Smith & Howe, Architects, New York.

The above work comprises a series of seven designs for chapels of convenient and tasteful design, and adapted in cost to meet the requirements of small congregations intending the erection of a modest house of worship. The buildings vary in cost from $900 to 3,500. They are offered for examination and approval by the above firm of architects, with whom those contemplating the erection of a chapel may find it serviceable to communicate.

W. T. Comstock's Catalogue. We have just received from W. T. Comstock, publisher of architectural works, at 194 Broadway, New York, the latest edition of his catalogue. It forms a bulky pamphlet of 82 pages, abundantly interspersed with sample illustrations from his numerous publications. The list of works offered to the profession embraces many standard books, and the architect and builder will find it useful to have at hand for consultation.

OTHER PUBLICATIONS RECEIVED.

Industrial Progress in Gold Mining. A Review of the Gold Mining Industry of the United States. With appendix and notes. Published by the Mears Chlorination Company, Philadelphia. 1880. From the Company.

Quarterly Report of the Chief of Bureau of Statistics, Treasury Department, for the three months ended September 30, 1880. Washington: Government Print. 1882. From the Chief of the Bureau.

Second Report of the United States Entomological Commis-

sion for the years 1878-1879, relating to the Rocky Mountain Locust and the Western Cricket, etc. With maps and illustrations. Washington: Government Print. 1880. From the Secretary of the Interior.

History of North American Pinnipeds. A monograph of the Walruses, Sea Lions, Sea Bears and Seals of North America. By Joel Asaph Allen. Washington: Government Print. 1880. Being Vol. XII. of the miscellaneous publications of the United States Geological and Geographical Survey of the Territories, Dr. F. V. Hayden, Director. From the Secretary of the Interior.

Bulletins of the United States Geological and Geographical Survey of the Territories. (Hayden.) Vol. V., No. 4; and Vol. VI., Nos. 1 and 2. From the Secretary of the Interior.

Notes and Queries.

This department is intended to furnish, for the benefit of all our readers, information on any subject of a scientific or technical character falling within the field of THE MANUFACTURER AND BUILDER. *Any of our readers possessing additional or more correct information than that which we give relating to the questions, are cordially invited to communicate it to us for publication. We also request that all questions or answers be written on separate pieces of paper, and addressed to the Editor.*

QUESTIONS.

NOTICE TO CORRESPONDENTS.—In consequence of the fire which destroyed the building in which this journal has for years had its office, and which resulted in the total loss of all the effects of the paper, including all manuscripts and a number of made-up pages of the February number, we are obliged to reproduce a number of the questions of inquirers in this department as nearly as we can from memory. Should any mistakes or omissions occur, inquirers are requested to repeat their questions next month.—*Ed. M. & B.*

[2942] THE CHLORINATION PROCESS.—Will you please give an account of the chlorination process for extracting gold from ores; and also state the special features and merits of the Mears chlorination process, and oblige.—H. G., New York City.

[2943] BEST LIGHT FOR THE EYES.—Which do you regard as the best light for the eyes—gas or petroleum?—H. N. B., New York City.

[2944] ADULTERATION OF PAINT.—A correspondent writes to know how to detect the adulteration of paint, having the suspicion that a contractor has been employing inferior materials from those required in his contract.—* *

[2945] METEORS AND SHOOTING STARS.—Please inform a reader of your interesting journal, what causes the stars to shoot.—A. G. C., New York City.

[2946] PERSONAL EQUATION.—Will you please inform a regular reader of your journal what is meant by the term "personal equation." I met the expression several times in reading an account of the observations of a total eclipse, and am not sure that I rightly understand it.—S. D. A., Paterson, N. J.

[2947] NOISE IN STEAM PIPES.—Please inform me what is the cause of the cracking and snapping noise in steam pipes when steam is turned on or shut off? I asked the same question of another journal, but received no reply.—* *

[2948] ASSISTANCE TO INVENTORS.—I have always thought your advice to others was sound and sensible, but until now never asked it for myself. Now I would like some assistance, and come to you for it as an old and constant reader of the MANUFACTURER AND BUILDER. I have an invention which is considered by those to whom I have showed it, and who have good judgment in such things, to be a very valuable improvement in safety switches for railways; but I do not know how to bring it rightly to the notice of railroad companies as I lack personal influence, and have no money to spend in advertising it. If you can inform me how best to proceed under the circumstances, I will feel much indebted.—A. R. S., Worcester, Mass.

[2949] PRESERVING WOOD.—What is the best and most approved material and process for preserving wood?—* *

[2950] PROTECTING POSTS.—Which do you consider best for protecting posts from rotting, charring or pitching?—* *

[2951] QUESTION OF ENCROACHMENT.—A correspondent writes that he has found that the wall of his house encroaches about one inch on the land of his neighbor, and wishes to know the best thing to be done under the circumstances—whether to remove the encroaching inch of brick wall, or to pay the damages to his neighbor and recover from the contractor if the latter is responsible for the blunder. He was furnished with the correct line.—* *

[2952] LEATHER POLISH AND PRESERVATIVE.—A correspondent inquired to have a recipe for a leather polish that would not injure the leather, and that could be applied with a sponge. (Name and address lost, as well as another question, which we ask to have repeated.)

[2953] GYPSUM IN MORTAR.—Another inquirer writes to state that he has noticed that in the specifications for the construction of expensive buildings, it is stipulated that a certain quantity of gypsum be added to the mortar. He wishes to know if this has any advantage.—* *

[2954] TO CLEAN PAINT.—Please tell me how best to clean paint on wood-work —* *

[2955] TO REMOVE RUST AND INK STAINS.—An inquirer writes to know the most effectual way of removing iron mold or rust stains from white goods.

[2956] DIMENSIONS OF BOILERS.—Is there any rule followed by boiler makers to determine the dimensions of boiler per horse-power?—A. B. B., New York City.

[2957] WEIGHT OF AIR.—Can you give me the weight of the air for a cubic foot, and oblige?—O. W., Washington, D. C.

REPLIES.

[2942] THE CHLORINATION PROCESS.—The chlorination process of treating ores is based on the fact that chlorine gas vigorously attacks metallic gold and converts it into a soluble terchloride. It was first suggested and applied to the treatment of ores by the German metallurgist, Plattner. While chlorine will dissolve metallic gold very readily, it is found to have very slight effect on metallic oxides, so that the base metal associated with the gold is only slightly affected by it. The chlorination process, as generally practiced, may be described as follows: The first step consists in thoroughly roasting the ore if it contains sulphur, arsenic or other hurtful ingredient. The roasted ore is then cooled, moistened and loosely sieved into a cistern or vat having a double bottom, the upper one perforated and covered with a stratum of filtering material. The next step is the treatment of the ore in this condition with chlorine gas, which is generated by the action of sulphuric acid on a mixture of common salt and binoxide of manganese (or of hydrochloric acid on binoxide of manganese.) The gas afterwards is washed with water to remove any hydrochloric acid that might be carried over, and is allowed to enter the ore chamber between the upper and lower bottoms, being conducted through leaden pipes. The gas rises through the ore, and as soon as its presence becomes known by its smell, the top of the vat is securely luted on. After allowing the gas to act on the ore mass for from twelve to fifteen hours, water is added in sufficient quantity to cover the mass. Ter-chloride of gold formed by the action of the chlorine is readily soluble in water, and the solution is drawn off into suitable vessels for precipitation, the last traces of the gold chloride being taken out of the mass by repeated leaching, until chemical reagents show no trace of gold. The next step is the precipitation of the gold, which is commonly effected by means of ordinary sulphate of iron (copperas), a solution of this substance being added to the gold solution. The result is the precipitation of the precious metal in the form of a brownish powder, which is afterwards collected, smelted in suitable crucibles, and run into bars or ingots of very pure gold. The chlorination process is a very simple and effective one. The gold, however, must be in the metallic state; in case sulphides or arsenides are present, these elements must be thoroughly eliminated by roasting. This procedure drives off the sulphur, etc., and leaves the base metals present in the form of oxides. The drawbacks of the process, as described, reside chiefly in the enormous space required for the plant; the danger of having soluble metallic sulphates present by reason of imperfect roasting, which will cause some of the gold to be precipitated; and also of having organic matter present, which would have the same effect. The Mears process is a recent improvement on the old process of Plattner, and consists essentially in the construction of an apparatus and appliances for treating the ore with chlorine under pressure. The action of the gas by this means is affirmed to be much more rapid and energetic, and the time of the operation is thereby greatly shortened. The apparatus of the Mears process differs in many important details from that of the old Plattner process, to adapt it to its special work. The process has, so far as we know, made a very good record in practice. Our inquirer will be able to obtain more detailed information concerning the Mears process by applying directly to the company, whose address is, the Mears Chlorination Company, Philadelphia.

[2943] BEST LIGHT FOR THE EYES.—So far as the quality of their respective flames is concerned in their effect upon the eyes, there would be no choice so far as we know between the light from burning gas and that from a petroleum lamp. The chief source of injury from artificial lights is, however, their unsteadiness or flickering, which fatigues the muscles of the eye from the constant effort that must be made to accommodate the eye to the varying intensity of the light, and which finally reduces its sensibility, and impairs vision. As commonly used, petroleum is much less injurious to the eyes than gaslight, for the reason that the manner in which it is burned furnishes a very steady, unvarying light, while gas jets are very generally more or less flickering or unsteady. Youmans, in his "Hand-Book of Household Science," has an excellent paragraph covering the question propounded by this corresponent, which we reproduce in condensed form for his benefit, as follows: Sunlight never wavers or flickers; its action on the eye is equable and unvarying. But in artificial illumination, as it is impossible to perfectly regulate the supply of air and of combustible material, the light is flickering and unsteady. [This fact can be observed by noting a gas jet burned from a common fish-tail or bat's-wing burner.—*Ed. M. & B.*] The glass chimney of the Argand burner, however, produces the most constant and unvarying flame. The bad effects of these sudden and continual alternations in the brightness of artificial light may be shown by supposing that a minute object can be seen in light of 8, 9 or 10 degrees of intensity, but that the intermediate degree of 9 is best. Now, if sunlight be used, as it flows in a perfectly uniform manner without sudden variations, the retina and pupil adapt themselves to its quantity, and the eye may be used for a long time without fatigue. But if artificial light of 9 degrees be used, it may at one moment rise to 10, and at the next fall to 8, from the flickering of the flame, so that the retina and pupil have not time to accommodate themselves to the change, and a degree of temporary blindness or impaired distinctness of vision results, which is very straining and fatiguing to the eye. The remedy usually applied for this evil, is to increase the intensity of the light. If it be raised to say 14 degrees, it may be reduced to 13 or raised to 15 without immediate inconvenience to the eye, for there being an abundance of light, its variations are less sensible. This relief, however, is fraught with ultimate danger, for the retina is too much excited by this increase of one-half in the quantity of light admitted to it; and this state of excitement is but the prelude to an opposite state, in which the sensibility to light is greatly and perhaps permanently diminished. Unsteadiness of the object viewed, if the eye be long and closely directed to it, is a source of injury. It is thus that much reading in railroad cars, where the trembling or incessant movement of the print keeps the image in constant motion upon the retina, has a bad influence upon the eye. From the above considerations, our inquirer will have learned that unsteadiness or flickering of the light is a serious source of injury to the eyesight, As between gaslight and petroleum, leaving the question of cost entirely out of consideration, the former is to be preferred, when it is burned from an Argand burner, in which case it is nearly if not quite as free from wavering as a petroleum flame; and gas has the advantage of greater convevience and cleanliness. Where gas is burned from the common forms of burners, however, on account of the unsteadiness of its light, petroleum is to be preferred.

[2944] ADULTERATION OF PAINT.—The materials used for adulterating paints are numerous, and to give directions for detecting them all would demand an extensive article, and to apply the tests properly would also require considerable skill in chemical manipulation and imply likewise some knowledge of chemistry. We will give, however, a brief description of a practical method of determining the commonest adulterants of linseed oil and white lead, which may be of use to this inquirer. If the paint is already mixed, dissolve out the oil from a small quantity of the paint with a mixture of alcohol and ether. Evaporate off the ether, when the oil will commence to separate in oily globules. When this separation becomes pronounced, add water to the alcoholic solution. If a dense white, milky coloration ensues on the addition of the water, the linseed oil is adulterated with the cheaper and very common adulterant known as "rosin" oil. As to the coloring matter, treat this with dilute nitric acid (aqua-fortis) in a porcelain dish with the aid of gentle heat. Pour off the liquid when the action of the acid has ceased, and if no residuum is left the color is most likely pure. If, on the other hand, a residuum is left, treat it with another portion of nitric acid as before, to make sure that enough acid has been added to dissolve all the soluble portion, and pour off the supernatent liquid. If after this second treatment any residuum is left, the white lead has been adulterated The commonest adulterant is sulphate of barytes—heavy spar, which would be left behind in the above treatment. By weighing the material before treatment, and the residuum, the percentage of adulteration can be told. This procedure applies only to white paint (zinc or lead); with colored paints it would be worthless. If any importance attaches to the case named by this inquirer, we would not advise him to trust to his skill in detecting the existence of a possible fraud, but to place the work in the hands of an analytical chemist, with instructions to investigate the materials and report.

[2945] METEORS AND SHOOTING STARS.—In order to give an intelligent answer to this inquiry, it will be necessary to make a brief preliminary statement of the views of astronomers respecting the nature of meteors in general, and especially concerning the relation of these bodies to comets. The attention of astronomers was first called especially to the study of shooting stars, by the remarkable star shower of the year 1833. In studying this remarkably brilliant phenomenon, it was soon discovered that many similar phenomena had been witnessed at nearly regular intervals in former times. This discovery soon after led to another even more important, namely, that the nebulous masses from which these star showers are derived, revolve about the sun in regular orbits which intersect the earth's orbit. Following this, came the hypothesis first advanced by the American astronomer Kirkwood, and afterwards confirmed by Schiaparelli, that these nebulous masses or meteoric clouds were in reality the scattered fragments of disintegrated comets. This remarkable conclusion was reached on the strength of the following observations: First, the fact noted by Schiaparelli, that in several instances meteoric streams move in orbits identical with those of certain comets; and second, the observation of the actual disintegration of a comet, which was noticed in the remarkable separation of Biela's comet in 1845-46 into two bodies, and its complete disintegration on its return in 1872, when it appeared as a shower of meteors in November of that year. There seems to be no doubt of the entire accuracy of the above statement that the meteors popularly known as shooting stars, are really the fragments of disintegrated comets. There are abundant evidences in the historical references to comets to prove the fact of their separation into distinct bodies, as was observed with Biela's, and to prove the fact of their progressive diminution in brilliancy. The comet of Biela, which has been very fully studied, is specially interesting in the treatment of this subject. Referring to its

peculiar behavior, Prof. Kirkwood says of it: "At the return of 1845-46, Biela's comet exhibited a most remarkable appearance. Instead of a single comet, it appeared as two distinct bodies moving together side by side, at a distance from each other somewhat less than that of the moon from the earth. Astronomers, anxious to determine whether the cometary fragments had continued separate during an entire revolution, awaited the next return with no ordinary interest. The two bodies appeared at the predicted time (September, 1852), their distance apart having increased to 1,250,000 miles. In 1859, the comet was not visible, on account of its proximity to the sun." It was not observed on its return in 1865-66. The appearance of a remarkable shower of meteors in 1872 from the quarter of the heavens known to be the position of the comet, has already been referred to. These facts leave no room to doubt the progressive disintegration of the comet. Kirkwood sums up our knowledge of the subject in the following statements: "The fact, then, that meteors move in the same orbits with comets, is but a consequence of that disruptive process so clearly indicated by the phenomena described. In this view of the subject, comets, even such as move in elliptical orbits, are not to be regarded as permanent members of the solar system. Their débris becomes gradually scattered around the orbit; some parts of the nebulous ring will be more disturbed than others by planetary perturbation. Portions of such streams that nearly intersect the earth's path, sometimes penetrate the atmosphere. Their rapid motion renders them luminous. If very minute, they are burnt up or dissipated without leaving any solid deposit; we then have the phenomena of shooting stars. When, however, as is sometimes the case, they contain a considerable quantity of solid matter, they reach the earth's surface as meteoric stones.

[2946] Personal Equation.—By the term "personal equation," scientific men wish to designate the disturbing effect of the personal characteristics of observers and experimenters in recording or noting the occurrence of any event or natural phenomenon. This factor is especially important to consider in the class of work that is referred to by this inquirer—namely, in astronomical observations. It has been found that the personal characteristics of the observer are a constant source of error. By numerous experiments, it has been ascertained that one who observes and records any occurrence, even though he may be well trained to the work, always gives a result which differs from the exact truth. If, for example, it is time that is being noted, the observer will record it either too early or too late, and the error will appear in each experiment and always to the same amount. If the record was too late in one, it was invariably too late. This habitual difference between the time as noted by an observer and the actual time of the happening of the occurrence, is what has been termed the absolute personal equation of that observer. It represents the amount of error that he will always make. It has been found to differ with different persons for the same class of events, and it differs likewise in the same person for different classes of events. The time required, for example, to observe and record the happening of a sudden and unexpected spark, is found to be invariably greater than that required in the case of the expected appearance of a letter or figure thrown upon a screen. The equation also differs according as the facts are observed by the use of one of the senses or of another, as the time required by some of the senses to convey intelligence to us is greater than that required by others.

[2947] Noise in Steam Pipes.—The primary cause of the loud hammering noises that are often so annoying to occupants of apartments heated by steam pipes, is the condensation of steam in the system of pipes. When the steam is first turned on, it takes some time for the pipes to become thoroughly heated, and the steam in contact with the cold metallic surfaces condenses. This water of condensation is further cooled off by contact with the metal, and in turn condenses the steam immediately in its vicinity, with more or less suddenness. The pressure being thus removed from one side of the water column, the body of water is driven by the elastic force of the air behind it, violently into the space occupied by the condensed steam, and, striking against the bends of the coil or the valves, it causes the cracking or hammering noise referred to. The water body is again driven forward by the steam, and it again condenses it, and the knocking is repeated, the blows often succeeding each other with great rapidity. Or some of the steam after admission may become shut off by the condensation between the two bodies of water, and the noise will then be caused by the violent impact of the two bodies of water rushing together to fill the vacuum. The familiar experiment of the "water hammer" will doubtless be recalled by this inquirer, and will explain how, in the absence of any resisting body like the air or other elastic body, a mass of water will strike a resisting surface with all the effect of a solid body. On account of the inconvenience experienced from this cause, provision is always sought to be made in steam heating apparatus to provide for drawing off the water of condensation in traps, thus removing it from the pipes and coils as rapidly as it accumulates. When the steam is shut off, the condensation of the residual steam in the pipes and coils may produce the same hammering noise, though to a less degree than immediately after its admission.

[2948] Assistance to Inventors.—We can only advise this inquirer in a general way by throwing out a few hints which he may find useful. The most feasible mode of procedure, it would appear to us, would be for him to make an application to some one of the technological or mechanics institutes to examine and report on the merits of his invention; and then, if the report be a good one and the invention is commended, to present himself with the report to one of the railway companies and state his case. With a backing of this kind, he will find it much easier to get a hearing than without it. There are a number of institutions that have the practice of aiding meritorious inventors in this way. An application of this kind addressed to the Massachusetts Institute of Technology, in Boston; the American Institute, in New York; or the Franklin Institute, in Philadelphia, would no doubt receive attention. The last named institution, we know, has for many years had a Committee of Science and the Arts established for this very purpose, and has been of great service to needy inventors through its reports, having made examination of and reported upon several thousand inventions. With a commendatory report on the invention, this correspondent might perhaps find it more serviceable to go directly to some influential person and succeed in interesting him in bringing it to the notice of some of the railway companies, and securing a trial of it. If this correspondent has no better advice offered him than what we have given, he might find it worthy of a trial.

[2949] Preserving Wood.—The best material for preserving wood against decay, where it is exposed to water or buried in the ground wholly or partially, as in the case of wooden piers and timbers for wharves, railway sleepers and the like, is creosote oil. Many mineral salts, such as sulphate of copper, chloride of mercury, chloride of zinc, and the like, have been employed for this purpose; but experience has shown that the action of water sooner or later almost completely dissolves and washes out the impregnating substance and leaves the wood unprotected as before. It further appears that these mineral salts do not protect the timber against the ravages of the teredo and other boring worms which are so terribly destructive to timber in tropical waters. Creosote oil, on the other hand, affords far more efficient protection to timber. It is insoluble in water, and therefore is not readily washed out of the fiber, and it is shunned by the teredo and its fellow borers, appearing to act as a deadly poison upon all the lower forms of life, In comparison with the mineral salts, the record of creosote as a preservative and protector of timber for engineering structures of every kind, is vastly superior, and to-day it has almost completely superseded those substances for the purpose named. We remember to have seen some years ago a striking example of the protective influence of creosote. Several large blocks of timber which had been impregnated with creosote through about one-half of their extent, the other half having been left in their natural state, had been immersed for one year in the waters of the Gulf of Mexico, where the teredo is notorious for its destructiveness. The blocks were then removed from the water and examined, when it was found that the borers had completely riddled the unprotected half of the wood, which was honey-combed up to the very line where the creosoting ceased, while the creosoted portion was untouched and still completely sound.

[2950] Protecting Posts.—We are of opinion that neither charring nor pitching separately will be effectual in protecting posts from rotting; but when both methods are applied together, the benefits therefrom will be considerable. The philosophy of this advice will be readily understood from the following explanations: By carbonizing the end of a post, the exterior is protected from decay; but this does not prevent the entrance of moisture through the end of the post—in fact, the porosity of the charred portion rather facilitates its entrance. Neither does the dipping of the end of the post into boiling pitch effectually prevent it, for the dense texture of the wood prevents its deep penetration, and the entrance of moisture is only slightly hindered, not prevented. Where the wood, however, is first well charred, it is rendered porous to a considerable depth beneath the surface, and if then immersed in the melted pitch, the latter will penetrate deeply into it through the porous carbonized crust. By combining the two operations, therefore, a much more thorough impregnation of the post with pitch will be had, and the post much more effectually protected than when either of the operations is used singly. In protecting posts in this manner, it should be remembered that the most sensitive portion is just at the surface of the ground, or at what is called the wind and water line. Here the post is exposed most severely to the alternations of wet and dry, and at this line the process of decay is most rapid. To thoroughly guard against this, the post should always be charred and pitched to some distance above the ground line.

[2951] Question of Encroachment.—In the case named by this correspondent, which is not an unusual one, the cost of removing the encroaching inch of wall would be about as great, and the trouble greater, than tearing down the wall and rebuilding it. This expedient, therefore, is not to be thought of. As to the question of responsibility, there can be no doubt, at least under the laws of New York and Pennsylvania, if the wall was built under contract, and the contractor was furnished with the correct line by survey, that the contractor is liable for any blunder that may have been made that would involve infringement on adjacent property; and any pecuniary damage that this correspondent may suffer by reason of the mistake, can undoubtedly be recovered from the contractor by process of law. The course of our inquirer appears to be clear—that is, either to oblige the contractor to rebuild the wall on the right line, or to have the damage to the owner of the adjoining property assessed, and proceed against the contractor legally to collect the sum with costs. If the work was done, however, by what is known as job or day work, and not by contract, the question may be more complicated, for, in Pennsylvania, at least, our inquirer would then have no redress.

[2952] Leather Polish and Preservative.—The composition given below, will, we think, be found to answer this inquirer's purpose. It gives a fine luster, and as it contains no acid, it does not injure the leather; on the contrary, the glycerine it contains is an excellent preservative of leather, rendering it soft and pliable, and adding materially to its durability. The composition here referred to, is substantially a mixture of gutta-percha and glycerine, with suitable coloring matter, made after the following mode of operation: The gutta-percha is first cut into fine chips, and 4 or 5 ounces of these put into a kettle or other vessel and melted or dissolved in 20 ounces of sweet oil, to which 2 ounces of stearine are added. Then in another vessel 3 or 4 pounds of lampblack and ½ pound of ivory black are covered with 5 pounds of glycerine and 5 pounds of molasses syrup, and well stirred until the whole mass is intimately mixed and free from lumps. While the gutta-percha solution is still warm, it must be incorporated with the glycerine solution; and after this is done, 10 ounces of Senegal gum dissolved in 1½ pounds of water is added. A few drops of oil of lavender or rosemary may be added, if desired, to impart to the mass a pleasant odor. This paste should be thinned with from 3 to 4 parts of water before using. This composition is said to give a fine luster to leather. It can be applied with a pencil or sponge, and requires no brushing to bring out a polish, and it does not injuriously affect the leather, as many paste and liquid compositions do. On the contrary, the glycerine which it contains is an excellent dressing for leather, rendering it soft and elastic, and adding materially to its strength and durability.

[2953] Gypsum in Mortar.—We have made diligent inquiry among a number of our builders, and cannot find that the statement of our inquirer is confirmed. We cannot see what advantage would result from the admixture of gypsum with lime mortar for brick-work. It has the property of setting rapidly; but while this might be desirable, it has the disadvantage of notably diminishing the strength or binding quality of the mortar. For interior work this objection would not hold good, and there the quick setting quality of gypsum might make its use advantageous. As a finishing coat for interior walls, the use of gypsum is universal.

[2954] To Clean Paint.—The following directions are simple, and will be found to answer very satisfactorily for cleaning paint on wood-work: Provide a plate with some of the best whiting, and have ready some clean warm water and a piece of flannel, which dip into the water and squeeze nearly dry; then take up as much whiting as will adhere to it, apply it to the painted surface, when a little rubbing will quickly remove any dirt or grease stains. After this, wash the part well with clean water, rubbing it dry with a soft chamois. Paint thus cleaned is said to look as well as when first put on, and the operation may be tried without fear of injury to the most delicate colors. It is said to answer far better than the use of soap, and does not require more than one-half the time and labor. Another simple method is the following: Put a table-spoonful of aqua ammonia in a quart of moderately hot water, dip in a flannel cloth, and with this merely wipe over the surface of the wood-work. No rubbing is necessary. The first recipe is preferable, except where the paint is badly discolored.

[2955] To Remove Rust and Ink Stains.—To remove rust or ink stains from white goods, it will generally be found effectual to apply a little muriatic acid in the manner to be described below. Moisten and steam the spots thoroughly by holding the part to be cleaned over a tin cup (or something of the kind) containing water boiling hot. When the spot is thoroughly heated, apply a little muriatic acid, rubbing it over the spot with the glass stopper of the bottle. One or two applications with a little rubbing will generally accomplish the object. Wash the acid out thoroughly with hot water, then rub the part well between the hands after rubbing with soap, and finally rinse off with clean water. Or, for the same purpose, lemon juice, or salt of sorrel (oxalate of potassa), may be used. For stains of long standing, the powder of oxalic acid applied to the spots in the manner above described, with the finger, is also effectual. When either acid is used, the goods should be thoroughly washed with water after the operation, to remove it. It should be remembered also that oxalic acid is an active poison, and if kept in the house, should be kept out of the reach of children.

[2956] Dimensions of Boilers.—Different makers differ in their rules for dimensions of boilers. The following estimates, however, are safe: For each nominal horse-power a boiler should have 1 cubic foot per hour; 1 square yard of heating surface; 1 square foot of fire grate surface; 1 cubic yard capacity; 28 square inches flue area; 18 inches over bridge. For cylindrical double flue boilers, an approximate rule is:

$$\frac{\text{Length} \times \text{Diameter}}{6} = \text{Nominal horse-power.}$$

[2957] Weight of Air.—A cubic foot of air weighs 538.1 grains, or something over 1 ounce; 13.06 cubic feet weigh 1 pound. About 65 cubic feet of air furnish 1 pound of oxygen. An apartment 8 feet high, 12 feet wide and 13 feet long contains about 100 pounds of air; and a room 40 feet square and 18 feet high contains about a ton.

THE MANUFACTURER AND BUILDER.

A PRACTICAL JOURNAL OF INDUSTRIAL PROGRESS.

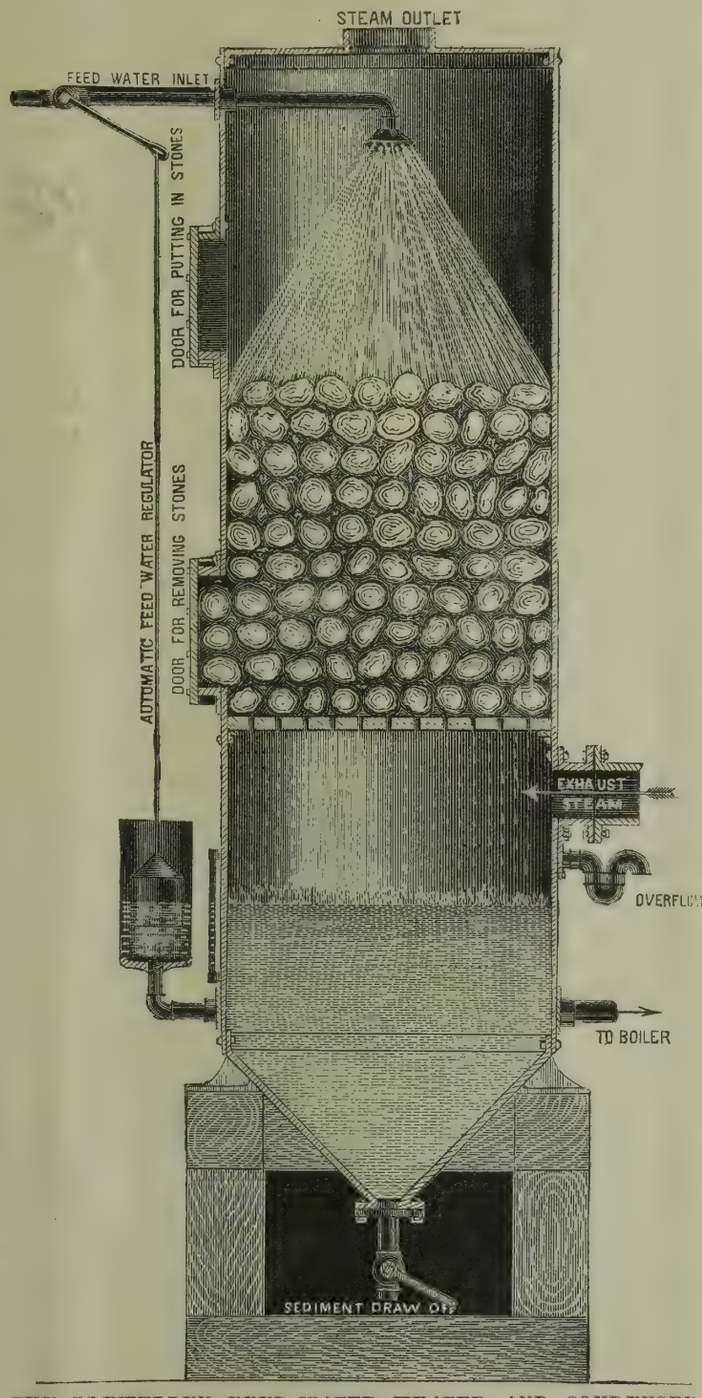
Vol. XIV.—No. 3. MARCH, 1882. Fourteenth Year.

The Llewellyn Feed-Water Heater and Condenser.

The evil consequences following the use of impure water for feeding steam boilers, both with respect to the loss of useful heating effect and the serious dangers following the overheating of the plates, have been so often pointed out in this journal, and are already so well known to all intelligent steam users, that their repetition in this place appears to us to be quite unnecessary. The subject, in fact, has come to be a stereotyped warning, and we shall boil it down to the briefest statement of facts.

The attachment of scale to the heating surfaces of a boiler, means the interposition between the iron shell and the water to be heated, of a stratum having about 50 times less heat-conducting capacity than the metal. The interposition of this non-conducting substance presents a serious obstacle to the rapid transfer of heat to the water—so serious, in fact, that when the deposit is permitted to accumulate until it attains a notable thickness, it represents an enormous loss of heating effect, or, to put it differently, an enormous waste of fuel. The attachment of scale to the heating surface, again, is also attended with serious danger to the plates of the boiler, because of the necessity of excessive firing to produce the required amount of steam. With water in contact with clean metallic surfaces, no amount of firing can work any injury, the plates can never be overheated, and the consequence will be simply the more rapid and energetic formation of steam. Where the metallic surface, however, is covered with a firmly adherent layer of cement-like scale, which opposes the free transmission of heat, the firing must be correspondingly increased, and the metallic surfaces exposed to the flame, not being able to transmit the heat freely to the water through the opposing stratum of non-conducting material, is liable to suffer severely from overheating. Where the evil is allowed to go on unchecked by carelessness or ignorance, or where, from the exigencies of business, the removal of the scale is not effected at frequent and regular intervals, the evil consequences here spoken of soon become apparent in the serious deterioration of the iron from overheating. Disastrous explosions, due to the weakening of the boiler plates from this cause, are not uncommon.

Knowing the wastage and danger of scaling in their boilers, intelligent steam users have adopted various methods of meeting and avoiding them. As all natural waters (whether derived from springs, wells, rivers, lakes, etc.) invariably contain scale-forming impurities, preventives of this form of trouble are almost universally in use. They are in many cases simply mechanical; the boiler being shut down and emptied, and when cooled off, entered by a workman who removes the scale as far as it is possible to reach it, with a hammer. Another plan which is generally practiced, is the chemical method. It consists generally in putting into the boiler from time to time a quantity of some anti-incrustator, which shall have the effect of precipitating the scale-forming impurities of the water in floculent or pulverulent form, so that they will not adhere to the plates or boiler. The loosely aggregated mass is permitted to accumulate in the mud drum, from which it may from time to time be blown out. By another plan of a similar nature, the purification of the feed-water is sought to be effected before its admission to the boiler, by employing large settling or precipitating tanks, and adding the chemical precipitant in sufficient quantity to effect its deposition.



THE LLEWELLYN FEED-WATER HEATER AND CONDENSER.

Another system, which effects much the same results in a more practical and less circumstantial manner, is represented by the use of what have been popularly named feed-water heaters and purifiers. These, as the name implies, accomplish the purification of the feed-water by heating it in a suitable apparatus in connection with the boiler, to the point where the separation of its scale-forming constituents occurs, provide for the retention of these separated impurities, that would otherwise attach themselves as scale to the boiler surfaces, in the chamber of the apparatus, either by subsidence or filtration, and pass the purified water into the boiler.

Many devices of this nature have been invented, all of them exhibiting more or less mechanical ingenuity in their construction, and as a class they have been found to be so convenient and efficient in practice, that they have come to be very generally used. It is hardly necessary to add that the exhaust steam is invariably employed to furnish the heat necessary to effect the precipitation of the mineral impurities. They not only, therefore, measurably purify the feed-water, but utilize more or less perfectly the heat of the exhaust steam, which would otherwise be wasted, to heat the feed, putting this into the boiler at a temperature at or near the boiling point, thus accomplishing at once two desirable objects.

We have occasion from time to time to present to our readers new devices of this character, embodying some novel or meritorious features of construction or operation, and will take the opportunity in this article to describe one of the latest of these—the Llewellyn feed-water heater and condenser, which has been largely and successfully employed by steam users on the Pacific coast during the past year, and it comes to our notice with a high reputation for simplicity of construction and effectiveness in service.

It consists of a cylindrical shell or case of wrought iron, furnished above with a flat covering having a central orifice for the escape of any uncondensed vapors, and terminating below in a hopper-shaped base of cast iron bolted to the shell, which is provided with a pipe and valve for drawing off the sediment and precipitated material which accumulates therein. The feed-water is admitted through an inlet pipe,

seen at the upper left-hand side of the apparatus, and provided with a rose-jet, by which the water is distributed in the form of a fine spray. A little below the center of the heater a grating is placed across the shell, resting on an angle-iron flange, and dividing the cylinder horizontally into an upper and lower part. This grating is intended to support about 3 feet of stones of irregular shape and size (stones of from 4 to 6 inches diameter are preferred), cobble stones being the most desirable if they can be procured. For the admission and removal of these stones two doors are provided, seen in the cut, on the left-hand side of the shell.

Below the grating, on the right-hand side, is seen the opening for the admission of the exhaust steam; below this, on the same side, the pipe communicating through a pump or injector to the boiler; and between the two an overflow pipe to draw off the surplus should the heater act faster than the boiler requirement. To provide against this contingency, however, a float regulator is employed (seen on the opposite side of the chamber), which automatically governs the valve of the feed-water pipe and regulates its supply.

The action of the apparatus is as follows: The cold feed-water entering through the inlet at the top, is distributed uniformly in spray over the surface of the stones, and trickles down through them. The exhaust steam entering from below, is thus met with an extended condensing surface of cool water, by which it is quickly and completely condensed before it reaches the upper surface of the stones. The mineral matter held in solution is more or less perfectly separated by the heating of the water, and is deposited chiefly upon the surfaces of the stones, while the heated and purified water finds its way through the grating into the reservoir below, from which it is fed to the boiler, the surplus of sediment and precipitate accumulating in the hopper below, from which it can be blown out from time to time by opening the valve provided for the purpose.

This apparatus differs from most of the feed-water heaters of its class, by bringing the exhaust steam into direct contact with the feed-water; its condensation is, therefore, very rapid and complete, and a material saving in water is thus effected, which, in some situations where water is measured through a meter, will amount to a substantial saving in the year. The heater delivers the water into the boiler at or near the boiling point, and materially free from scale-forming impurities. After a certain period, variable according to the quantity of impurities the water contains, the interstices between the stones become filled up, and they must then be removed and replaced by others. This state of things is indicated by the fluctuations of the load on the water gauge.

The makers claim for this apparatus that it is a simple and efficient heater and purifier; a simple and rapid condenser; that it can be placed in any convenient position near to or removed from the boiler; that it assists the engine by affording immediate relief to the exhaust; that its construction is so simple that there is nothing about it to become disordered; that the inflow of feed-water is automatically controlled, making the apparatus self-regulating; and that as a heater, purifier, condenser and fuel-saver it represents a simple and effective device, from which the best results and highest economy possible with this class of apparatus may be realized.

Messrs. Parke & Lacy, of San Francisco, Cal., have purchased the Eastern state-rights for the manufacture and sale of this heater and condenser, and are now sole proprietors for this section. H. N. Black, 21 Park Row, New York, is their representative here, and will receive and give prompt attention to all communications.

Oldest Timber in the World.—The ancient temples of Egypt are believed to contain the oldest timber in the world, in the shape of dowel pins, which are incorporated with stone-work known to be not less than 4,000 years old. These dowel pins, according to the appearance they present, are thought to have been made from the tamarisk or shittim wood—in ancient times a sacred tree in Egypt.

The Manufacturer and Builder.

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This journal has the largest circulation of any mechanical monthly published in the United States. Its value as an advertising medium is therefore apparent.

Vol. XIV., No. 3. Fourteenth Year.

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A Special Edition for May, 1882.

We propose, in accordance with our custom at stated intervals, to issue an extra edition of 10,000 copies of the May number of the Manufacturer and Builder, over and above our usual issue. This plan which gives our regular advertising patrons the benefit of an extra circulation, judiciously directed to such lines of manufactures, as in our judgment will be of the most service to them, is worthy of the special attention of those who are classed among our occasional patrons, to whom we take this opportunity of commending it as an unusually good chance, presenting the merits of their specialties to the most desirable manufacturing elements throughout the country. No addition to our usual schedule of prices will be made for advertising in this number, and as these "extra" issues have proved their popularity in the past, we are satisfied that this notification will be all that will be required to insure a large participation in the exceptionally good opportunities for advertising which the special edition of our May number will afford.

"Be Sure You're Right, then Go Ahead!"

Of all persons, he who assumes the grave responsibility of criticising another, should be mindful of the prudent saying popularly ascribed to Davy Crocket, "Be sure you're right, then go ahead!" We are led to make this remark from having seen in the *Mechanical Engineer* a criticism of some statements that originally appeared in the "Notes and Queries" department of the Manufacturer and Builder, and which statements were copied by a journal called the *Industrial World*, without credit to us. It therefore appears, as will be seen, as if the criticism we refer to reflected upon the *Industrial World*, and not upon us. Nevertheless, although the *Industrial World* was not polite enough to give us credit for its extract from our columns, we feel sufficiently interested to father the article and to answer the critic. We copy from the *Mechanical Engineer* (of Feb. 18th, page 58) the following, under the caption "Decomposition of Steam":

"It has been observed that in the formation of water by the union of hydrogen and oxygen, 2 parts by volume of hydrogen unite with 1 volume of oxygen. The resulting water vapor, however, does not occupy 3 volumes, but 2 volumes, which proves that condensation takes place in the combination. If the operation be reversed, and water vapor is decomposed into its elements, it is obvious from the above that 2 volumes of steam would yield 3 volumes of mixed hydrogen and oxygen gas; or, 1 volume of steam will afford 1½ volumes of the mixed water gases—that is, 1 cubic foot of steam would yield 1½ cubic feet of water gases, supposing the temperature and pressure to be the same after the decomposition as before it. If the decomposition of steam is supposed to take place in an enclosed vessel, where no change of volume can occur, the result of the decomposition will be to increase the pressure in the same proportion as the volume would have been increased—namely, one-half. In a steam boiler, for example, these conditions would exist, as the gases would be confined and not permitted to change their volume. The pressure, therefore, would be increased proportionately. An initial pressure of 20 pounds would become 30; an initial pressure of 30 pounds, 45, and so on".—*Industrial World.*

"No; the equivalents of watery vapor and hydrogen are not the same. The hydrogen is much the lighter. One volume of oxygen = 1.106; two of hydrogen = 2×0.069 = 0.138. This makes two volumes of steam at 1.244. One half of this is the weight of one volume of steam, or .622; while a boiler full of hydrogen is very much less, or as .069 is to .622, about nine to one.".—*Eds. Mechanical Engineer.*

To verify our assertion respecting the authorship of the statements here criticised, and attributed to the *Industrial World*, we refer those who may be curious upon the subject to the "Notes and Queries" department of the Manufacturer and Builder for January, 1882, where, on page 24, the quoted paragraph appears as an answer to the following question of A. W. R., of New York city, namely: "What would be the increase of volume resulting from the decomposition of steam into its elements? or, if in a confined space, as in a steam boiler, what would be the increase of pressure?"

Now, as to the comments of the *Mechanical Engineer*. It is difficult to understand just what the writer is driving at. His comments are obviously intended as a criticism upon our statements, for he starts out with an emphatic and ominous "*No*," which can only be interpreted to mean that he denies their correctness. But the statements that follow the "no" have no bearing whatever upon the facts stated in our answer. Considered in the light of a criticism, the statements of the *Mechanical Engineer* are so entirely of the *non sequitur* order, that we can only explain them on the supposition that the writer's ideas upon the subjects of specific gravities, combining volumes, and tensions of gases and vapors, are the reverse of lucid.

The first of his comments may be briefly stated thus, that the specific gravity of steam is .622, while that of hydrogen is very much less. These are well-known facts that no one will dispute; but what bearing they have on the question of the increase of volume resulting from the decomposition of steam into its elements, or upon the question of the increase of pressure where the decomposition takes place in a confined space, is beyond our comprehension. If the writer will inform us, we will be his debtor. We made the assertion in our article that 1 cubic foot of steam will yield 1½ cubic feet when dissociated into its elementary gases, supposing the temperature and pressure to be the same after the decomposition as before it, and that if this dissociation of steam into its elements should take place in a confined space, where no change of volume can occur, the pressure would be increased proportionately—that is, one-half. These statements we repeat, and reassert their accuracy.

We cannot dismiss the criticisms (?) of the *Mechanical Engineer* without a few additional comments. There is something closely approaching absurdity in the utter absence of logical connection between our statements and the writer's comments thereon. It is precisely as if he had manufactured an opponent to enjoy the gratification of knocking him down. He says, for example: "The equivalents of watery vapor and hydrogen are not the same." Who said they were? And again: "The hydrogen is much the lightest." Very true. We have been credibly informed that it has been used successfully for inflating balloons.

His final statement contains a gross error in simple arithmetic, an evidence of carelessness that is in keeping with the absurdity of the entire criticism (?). The writer says: "A boiler full of hydrogen is very much less (*i. e.*, in weight), or as .069 is to .622—*about nine to one!*"

We had thought to dismiss the *Mechanical Engineer* with the above remarks, but in looking over its pages our eye was caught by an editorial with the interesting title "Gas as an Agent in Boiler Explosions." With a lurking suspicion that the editor might advance, under so suggestive a title, some highly original views, we read the article. Our expectations were more than realized. We found that we had struck a regular "bonanza"—a "pay streak" of unusual richness. This is what we found:

"Hydrogen is an explosive gas under certain conditions, and in this apparatus we have all the essential features of a steam boiler. Overheated tubes present the necessary surface, while the vapor or steam contains oxygen enough to combine with it and decompose, setting free the hydrogen.

Suppose we have obtained these conditions, suppose we have decomposed the steam, as shown, what follows: A boiler full of hydrogen gas, which is the lightest gas known to science. It is more than fourteen times lighter than atmospheric air! We have therefore very nearly a perfect vacuum in the boiler, and the engine, under the state of things named by us *would immediately begin to run backward!*"

For originality, the declaration, that *because* hydrogen is more than 14 times lighter than air, *therefore*, if steam should be decomposed in a boiler by contact with overheated tubes, and the boiler thereupon should be filled with hydrogen, we should have, as a consequence, "*very nearly a perfect vacuum in the boiler*," surpasses anything that has lately come under our notice.

No further evidence than this is necessary for our readers to estimate the competency of the author of such an amazing error to aspire to the eminent functions of a critic. We would kindly suggest to our contemporary, if he does not desire to become famous for the infirmities of his intellect, to employ some person to prepare his scientific editorials, who has at least an elementary knowledge of physics and chemistry. And lest he should imagine we are joking, we will point out the grave errors into which he has fallen in the statement we have quoted.

The author of this statement labors under the profound misconception that there is a necessary connection between the tension of a gas and its specific gravity; whereas such tension is controlled by two other factors, namely, pressure and temperature. Under the hypothetical circumstances stated by the writer, where hydrogen would be liberated in the decomposition of steam by contact with overheated tubes in a steam boiler—the oxygen of the steam disappearing in combination with the iron—the volume of the resulting hydrogen would be precisely equal to that of the volume of steam decomposed (presuming that we leave out of account the heat absorbed in the work of disrupting the elements of water, and that developed in the combustion of the oxygen with iron), and its tension (*i. e.*, the pressure it would indicate on a pressure gauge) would be practically the same as that exhibited by the steam before its decomposition.

The author's conceptions on this subject are, therefore, completely wrong. There would *not* be a nearly perfect vacuum in his boiler in the hypothetical case stated by him, nor would the engine *run backward*.

Railway Accidents.

The recent accident on the New York Central & Hudson River Railroad by reason of the widespread notice it received from the comments of the daily press, has aroused the serious attention of the public to the fact that in spite of the great advances that have been made of late years in throwing safeguards around railway travel, there is still much room for improvement. We have safety platforms, safety switches, and power brakes. On all the old established roads we have double tracks, and in some cases even a separate set of tracks for freight traffic, so that trains upon one track shall always run in the same direction, to avoid collisions in part, and in some cases the system of block signaling, by the operation of which the engine driver is advised whether he may enter the section ahead of him, and by which it is designed to prevent such accidents as the lamentable Spuyten Duyvil disaster, by collision from the rear. It is not demanding too much to say that all railway companies should be required to employ every reasonable precaution to avoid accidents and to insure the safety of the traveling public, and when it is asserted that the use of the block signal system such as has been for some years in very satisfactory use on the Pennsylvania Railroad Co. would have prevented the accident referred to, the inference we wish to draw from the fact, is that if railway companies will not voluntary adopt safeguards that have demonstrated their efficiency, they should be compelled to do so. For the particular class of accidents of which the Spuyten Duyvil disaster is a special example, the fact is not questioned that the block signal system affords the most efficient protection that human ingenuity has yet succeeded in discovering. On this account, and because this form of accident is next to derailment—the most common that menaces human life—the adoption of this system or of something similar to it, should be made compulsory.

Another reform that is loudly demanded is the adoption of some mode of heating railway cars without the aid of direct fire, by stoves as is now commonly practiced. The after-consequences of a railway accident to-day are frequently more horrible than the accident itself. Truly human ingenuity is equal to the task of devising some simple means of warming railway cars without the use either of direct fire or of steam, by one of which the mangled or imprisoned victims of an accident are made to suffer the agonies of being roasted alive, and by the other, the equally horrible alternative of parboiling. In Europe, where the compartment coaches are in vogue, in place of the long cars with which we are familiar, this problem is simply solved by introducing at suitable intervals cylinders of hot water, on which the passengers place their feet, or by the aid of cylinders charged with chemical substances whose extraction produces the desired heating effect. The plan of our cars renders the adoption of any matter of this kind difficult or impracticable, but the problem is by no means impossible of solution, and the fortunate inventor who will devise a plan that will combine the elements of safety with economy and simplicity of operation will be a benefactor to the traveling public, and will deserve the substantial reward that will doubtless fall to his share.

Returning again to the safeguards to be provided against derailments, collisions and the like, we may add to what we have said above, that while the block signal system affords the most efficient preventive against the accident of collision from the rear, it is nevertheless open to the objection that its perfect operation depends upon the vigilance and constant attention of the operator and the engine driver; and where this is the case it is only a question of time when the most vigilant and faithful man will mistake or blunder. What is wanted is a block signal system that will dispense with the intervention of human aid in giving its warnings, and that in the event of the dangerous passing of a train ahead, will bring the engine to a stop, automatically, as the safety-switch now in general use will sight itself, automatically, and prevent derailment of the train, even if it be intentionally or through negligence set wrong. This may seem to many as a thing too difficult to be realized, but we are satisfied that if the problem is intelligently attacked, dozens of methods of solving it will present themselves. Here is a chance for an inventor to realize fame and fortune.

The suggestion has been made by one of our contemporaries to avoid the loss of life in near collisions by making the last car of a train purely a safety one, a sort of buffer car to receive the shock, and from which, by its interposition, the passengers would be safe. This would no doubt answer the purpose of saving life in many cases, but we doubt if this plan would be received with favor by the railway companies, since to answer its purpose effectively it would require to be constructed with especial reference to its intended function, or if a car of ordinary contruction the chances are ten to one that the temptation to use it in the frequent cases of overcrowding would often prove too strong to be resisted.

The last decade has witnessed a very decided advance in the provisions for increasing the safety of railway travel, but much still remains to be done, and can be accomplished in this direction.

Houses of the Japanese.—Japanese houses, although ingenious examples of wood-work, do not last long. It is said that Tokio has to be rebuilt once in every period of seven years. A German chemist in the employment of the Government proposes, as the only way to give security, that the erection of timber houses should be abandoned. Stone is not much used, owing to the scarcity of materials for mortar; but it has been discovered that much of the surface in Japan is of volcanic origin and corresponds with puzzolana. This stuff, if mixed with one-sixth of lime, forms, it is said, an excellent cement, which may be utilized in the erection of houses. The Japanese have so readily adopted European ways, it may be assumed that they will consult their own interest and adopt the suggestion of the German chemist.

Lessons in Wood-Carving.

There has been of late years a most noticeable and gratifying interest shown in the introduction of the artistic element into the industries, as a consequence of the more general appreciation among our people of

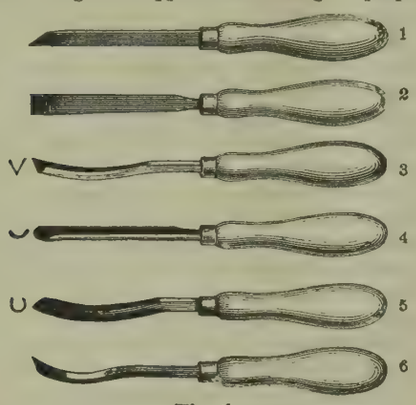


Fig. 1.

the beautiful in union with the useful. This is shown not only in the superior artistic quality visible in the products of most of our manufactories, notably in those branches that relate specially to household decoration, but also in the establishment in our manufacturing centers of schools of industrial art.

One of the many evidences of this strong development of artistic perception, is the interest which is shown in the elegant and useful art of wood-carving. There is, it is safe to say, as much native artistic talent in this country as in any other, but it is undeveloped for the want of the spur to force it to activity.

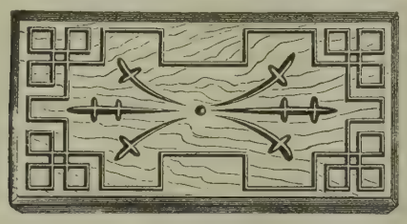


Fig. 2.

The art of wood-carving is not difficult to acquire, though, of course, elaborate work is not easily done. As the traditional Yankee, however, is invariably represented with his jack-knife in hand, one would think that in the land of whittlers wood-carving should take rank among the most widely practiced of the elegant arts. Though this is far from being the case, for want hitherto most probably of the guides and facilities for giving proper artistic direction to the crude and undeveloped artistic talents of our people, this state of things bids fair soon to disappear before the rapid multiplication of schools of art and the rapid growth of opportunities everywhere for the cultivation of the artistic element.

These comments have been induced chiefly by the inspection of an admirable little manual devoted to the artistic treatment of wood, giving, among other interesting lessons, plain instructions in the rudiments of wood-carving. This manual is issued by A. H. Shipman, of Rochester, N. Y., and we deem this portion of its contents of sufficient interest to reproduce certain parts of it for the instruction of many of our readers, especially the younger ones among them, who may find the subject specially attractive.

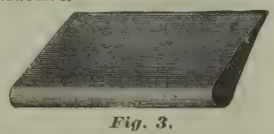


Fig. 3.

Carving is only a higher grade of whittling, in which the jack-knife gives place to the chisel and the gouge; and it would astonish most people to be shown what may be done with these simple tools. Not only may such elegant trifles as brackets, book-rests, paper-knives, picture frames, etc., be made by the home carver, but chairs, tables, sideboards, bedsteads, and other domestic articles may be ornamented in this way. A degree of skill that will enable the worker to produce fairly good and satisfactory results, may readily be acquired with a little patience, and any boy or girl with ordinary mechanical ability has it in his

Fig. 4.

or her power to soon learn the art of carving many articles of utility, and thus, by adding to the artistic decoration of home, to have acquired a never failing source of gratification, if not indeed a pleasant means of acquiring a livelihood.

To such as may feel a desire to learn the rudiments of wood-carving, the following lessons will be found useful: The first lesson of the amateur is to learn the use of the three principal tools—the flat chisel, gouge

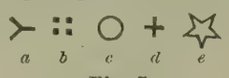


Fig. 5.

and veining tool (Nos. 2, 3 and 4), shown in Fig. 1. For this lesson, take a block of white wood 6 inches long by 2 or three wide, and 1½ inches thick; secure it firmly to a bench, then with the flat chisel carve the beveled edges and make the miters perfect; now take the veining tool, No. 3, which cuts a V-shaped groove, and carve out the design as seen in Fig. 2.

In using this tool, hold it in the right hand and in a slanting direction. The left hand should be hollowed and placed on the tool, the wrist and tips of the fingers resting upon the work. This steadies the right hand and prevents the tool from slipping forward. Now use the gouge, and carve out the circular depression which may be seen in the design. This lesson should be practiced until the design can be carved accurately. Fig. 3 shows a slip of Arkansas stone for sharpening the veining tool No. 3 and the gouges.

After mastering these tools so as to use them with ease, try carving a wall pocket, Fig. 4. The wood to

Rim of Bread Platter, Ornamented with "Relief Carving."

Fig. 6.

be carved should be black walnut, 12 by 14 and one-half inch thick. It must be well seasoned, straight grained, and free from knots. First give the outline shape of the design, as seen in Fig. 4, which may be done with an ordinary fret saw; then sketch the pattern upon the wood. A knowledge of drawing will greatly aid the carver, yet in many cases the drawing can be easily made by means of impression paper. Place the wood upon a table or bench, and secure it firmly with a clamp or screws. With the parting tool, No. 3, cut the V-shaped groove for the outline of the design. Having finished the grooving, use next some of the carving punches (Fig. 5 shows impressions made by five different styles). First use the punch *c* for making the three circular impressions in each corner; then with punch *b* go over the design as in Fig. 4. The cross-shaped punch *d* can be used to ornament the outer rim. Very handsome ornamental work can be done with only the punch *b*, and for this design it can be used to good effect without the aid of the other punches. In using the punch, hold it perpendicularly in the left hand, and with a mallet give it a sharp, quick blow. Furniture ornamented in

Fig. 7.

this style looks remarkably well, and the work is easily executed.

Relief Carving.—Our next lesson will be to carve a book rack with the grape-leaf pattern in relief, Fig. 7. The wood, either walnut, oak or mahogany, should be half an inch thick and 6 inches wide; but the proportions and sizes may vary to suit the wishes of the carver. Having sketched the design upon the wood, "stab out the work." This is accomplished by holding the chisel No. 2 upright on the line and pressing it downward to the depth of about one-16th of an inch. It is better not to cut exactly in the line, but keep just inside.

Fig. 8.

Fig. 9.

When the "stabbing" has been done, hold the chisel slantingly, and cut towards the pattern, thereby removing the wood near it and leaving it quite free. Then with tools Nos. 4 and 6 clear away the "dead" wood in the intermediate space, leaving the design standing up in relief. Notice carefully the grain of the wood. If the grain runs downward, turn the wood around and work the reverse way, or sideways. It will readily be apprehended that the whole of the branches and leaves which form the pattern should not lie on one dead level. The thickest portion of the stems, leaves and grapes should be the highest; the rest of the design must be harmoniously lowered. At this stage remove those parts which the design indicates are to lie very low. Be careful while working to "stab out" the line again and again, so that you may keep accurately to the copy. Next, you must "stab out" the whole design again, and deepen the groundwork until it is about a quarter of an inch lower than the upper surface, then carve the leaves, stalks and grapes, copying nature as far as possible.

Fig. 10.

In doing this there will be ample occasion to exercise individual judgment and taste.

Carved Fret Work.—Another popular style of carving is "carved fret work." For this lesson we will take a carved paper-knife, Fig. 8. Take a good piece

of black walnut, ten inches long, one and a half inches wide, and one-quarter of an inch thick. On this trace the design seen in the cut. With the fret saw cut out the pattern, as is done in ordinary fret sawing. Now, with the tools carve the design to imitate as closely as possible the natural leaf, flower and stalk. This being done, with sand paper and a knife bevel the edges and shape the handle.

Fig. 9 is a carved molding, in which the leaf and stem are to be left of the original hight of the wood, the other parts being cut away. The veins are cut with the parting tool, No. 3. It should then be punched with one or the other of the punches.

Fig. 10 shows a specimen of fret carving. The dark portion of the bracket shows it simply sawed out with the bracket saw. The other side has been carved.

All tools used in wood-carving should have sharp, keen edges. Do not try to carve with dull tools.

When the beginner has so far mastered the rudiments of the art as to be able to carve these designs with ease and accuracy, he will have acquired such manipulative skill in the use of the tools as to be able to rapidly perfect himself in the more difficult features of the art. Should he require them, he will be able to obtain numerous and elegant designs suitable for every class of work, by addressing the firm from whose manual we have gleaned the instructions above given.

Unification of Steam Boiler Inspection Laws.

The frequent discussions that appear in the technical journals respecting the reliability of the various methods of inspecting steam boilers in vogue, and the frequent occurrence of acrimonious proceedings in the courts, to fix the responsibility for loss of life and property, are matters very familiar to our readers. A short time ago, Philadelphia was the scene of a prolonged contest of this kind, which was fully discussed in the journals; and now Brooklyn, N. Y., in the Jewell flour mill explosion of a few days ago, affords the latest example.

These facts we refer to in order to point out more decidedly than without them, the grave necessity which has long been felt of a unification throughout the whole country of the laws relating to boiler insurance and local official inspection of boilers. We know of no better service that could be rendered to steam users, and to the public, than for the leading mechanical engineering societies of the country to co-operate in settling this important question. We would have some one of these bodies to inaugurate the movement, invite the co-operation of kindred bodies, and appoint a joint committee of conference to frame a proper set of rules for the limitation of steam pressures, and the proper mode and manner of conducting the inspection of steam generators.

A united movement of this kind would go far towards settling the difficulties now growing out of the diversities in the laws of various states and cities; and a recommendation from so responsible and authoritative a source would meet with respectful consideration, and very soon to general adoption.

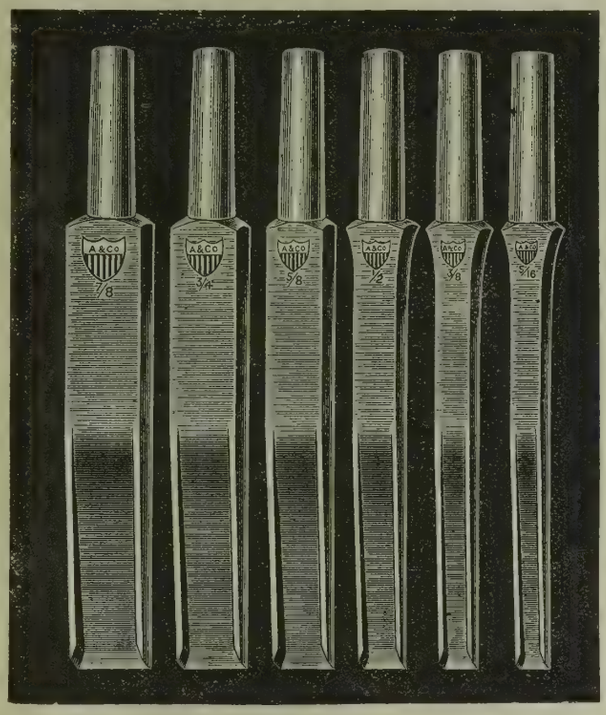
Franklin Institute.

An earnest effort is now being made by the friends of this venerable and useful institution to enlarge its facilities for work in promoting science and the mechanic arts, in which it has long occupied a preeminent position, by the erection of a new building with increased space for its library, lecture-room, laboratories, school-rooms and the like, of which it has seriously felt the need for a number of years. To this end, an effort is now being made to raise a building fund of several hundred thousand dollars, and already some fifty thousand dollars have been subscribed. It is expected that in the near future the entire sum will have been pledged. We know of no similar institution in the country that is more deserving of substantial assistance of this kind than the Franklin Institute, and offer its friends our warmest wishes for the speedy success of their project

Amesbury's Standard Mortising Chisels.

We have lately had the opportunity of inspecting a series of admirable mortising chisels manufactured by G. W. Amesbury & Co., of 3101 Chestnut street, Philadelphia.

These tools, of which samples of various sizes are shown in the adjoined cut, and which have become widely celebrated by reason of their excellent quality, are made of all the standard sizes; and because of the high reputation they have obtained for general superiority, we deem the fact worthy of notice in our



Amesbury's Standard Mortising Tools.

pages. The superiority which these manufacturers have attained in the production of their specialties, is attributable, first, to the careful and critical selection of the material, nothing but tool steel of the first quality being allowed to enter into their make-up; and secondly, to the mechanical skill and careful attention bestowed upon the shaping, tempering and finishing of the tools. Having acquired a well deserved reputation for the quality of their tools, the makers are wise enough to maintain and preserve it by keeping them fully up to the high standard which they have succeeded in establishing.

The increasing demand for these chisels has forced the manufacturers to increase their facilities, until now they have one of the most completely equipped shops in the country. They make all regular sizes, with shanks to suit all mortise machines in use, and fully warrant them.

In ordering chisels, the makers request that the name of mortisers be sent, or the old shank forwarded for sample.

Underground Air.

A lecture on "Underground Air" was recently delivered by Prof. Cameron, M.D., in Dublin. It was stated that the foundations of the houses of Dublin consisted of two-thirds solid matter and one-third air. It was a mistake to suppose that the air terminated at the surface of the ground. On the contrary, it extended into profound depths below the earth's surface. The air below the ground was not only abundant, but it was capable of circulating subterraneously in a wonderful manner. Gas escaping from the mains in the streets had been known to move a long way under the ground, to enter dwellings in which there were no gas-pipes, and to fatally poison the inmates. Striking experiments to prove the quantity of air in soils, and the permeability in the latter to gases, were made. A very large glass vessel full of earth was shown, water being let into it through a tube. Air issued from it in large quantities, and was conducted into a long glass vessel full of water, and inverted over water contained in a glass trough. The air which was forced out of the vessel filled with clay was seen to be about one-half of the volume of the vessel, which apparently was closely packed with clay. In a long glass cylinder a lively bird was exhibited. About a foot of gravel was beneath it, and the same quantity above it. The experiments went to prove that the air freely penetrated to the small open space between the strata of gravel. The nature of underground air was explained. It chiefly consisted of ordinary air, but it contained very much larger quantites of carbonic acid gas, and it teemed with low forms of life. When it came from sewers, or from soils reaching decomposing organic matter, a gas termed sulphuretted hydrogen was often present. It had a bad odor, which probably nature had given to it as a warning to animals to get quickly away from this noisome gas. The properties of underground air and simple tests to ascertain its presence were demonstrated by means of experiments. The lecturer stated that if it were impossible it would be desirable in building a house to set it down upon a foundation of asphalt, or of concrete and tar, shaped like an enormous tea-tray. No materials, save those containing tar or asphalt, effectually resist the passage of air and damp. In houses as they exist all that could be done was to take care that no old sewers or cavities of any kind existed beneath the basement floor. By the use of cement every chink in the floor should be stopped up. In a word, every aperture through which ground air could enter within the walls of a house should be stopped up. The bell-traps in the sinks were condemned, as they were often taken out of their place, in which there was a rush of cold heavy air from the street sewer into the house, where the air, being warm, was light. S and D traps were safer than bell-traps. As organic matter decomposing in the ground produced a bad ground air, it was important to avoid putting filth into the earth near houses. The quicker refuse matter was removed completely from dwellings the better for the health of their inmates. A great sanitarian had termed the contagious maladies "filth diseases," Therefore the cleaner the air and earth in and close to dwellings the healthier the latter would be. The air near the ground was very much colder than the air from six feet to fifty above ground. In winter, for this reason, as well as many others, it was most undesirable to sleep in basement rooms.

The Smallest Steam Engine in The World has been constructed by an American watch-maker named Buck. From a description we gather that the engine, with its boiler, its feed-pump, its speed-regulator, etc., occupies a space rather less than three square centimeters. The hight, exclusive of the base, is only sixteen millimeters. An ordinary thimble easily covers the whole. There are no fewer than 140 distinct pieces, connected by means of 102 screws. The boiler is filled with three drops of water. The course of the piston is 2.3 mm., and its diameter is slightly less than 1½ mm. The total weight is only one gram. The engine works perfectly.

Recent Inventions in Wood-Working and other Machinery.

Continuing our descriptions of recently patented improvements in wood-working machinery, we call attention in Fig. 1 to an improved circular saw mill for small timber, invented by Charles J. L. Meyer, of Fon du Lac, Wis. The invention relates specially to the method of handling and cutting small logs or timber into railway ties, saw-cants and like pieces, and the improvements embraced therein, are, first, to provide a continuous feed to and between parallel saws adapted to cut slabs simultaneously from each side of the log; second, to center the log automatically; and third, to secure or dog the small log upon its narrow carriage. These objects he seeks to attain by the mechanism illustrated in Fig. 1, which represents a vertical section of the machine. Parallel saws *x x* are mounted on a suitable frame, as shown. The log carriage consists of an endless chain A, travelling along the upper side of the frame on ways A′ A′ toward and between the saws *x x*, and is moved by drums *y y* at either end of the frame. This chain is provided with vertical sharp lugs *a a*, distributed in pairs upon the links at such spaces apart as may be desired, and which serve as head-blocks and dogs for the log. Four or more vertical standards B B of uniform length, size and shape, and parallel with and opposite each other, move through slides *b b*, attached to the outer shears of the frame, in front of the saws,

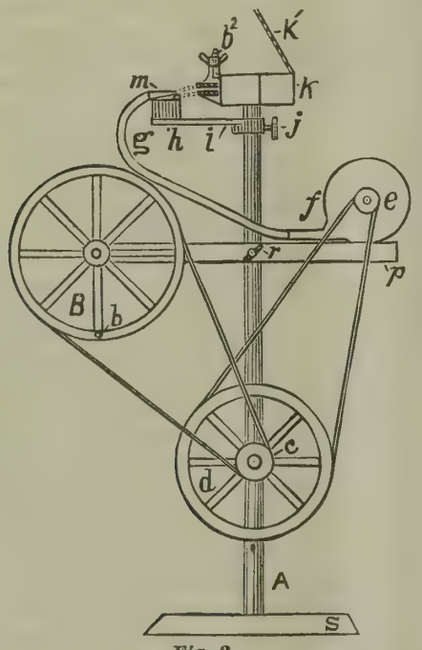


Fig. 2.

and are raised and lowered conjointly by means of bell cranks, links and lever, as shown, or by other equivalent mechanism. The heads of these standards are uniformly flared outwardly and beveled on their inner faces to form wyes. These standards being uniform and equidistant from the chain-carriage A, it is obvious that the log rolled into the wyes must rest with its axis perpendicular to and parallel with the center line of the chain-carriage; in other words, it must center itself. Upon reception of the log the standards are dropped, leaving the log squarely upon the lugs *a a*, and freed from the wyes. The lugs *a a* penetrate and clutch the bottom of the log, but they are necessarily so small and narrow that a further dog device is requisite. This dog is supplied with a heavy wheel C, provided with spikes in its periphery. This spiked wheel is suspended over the center of, and its axis is at right angles with, the chain-carriage A, and plays up and down in that position by means of the frame, slide-ways, pulleys, cord and balance weight *c d*, as shown. This spiked wheel engages and dogs the log as it reaches the saws *x x*, and as it passes between and is cut by the saws, the wheel revolves upon, and with its weight and spikes holds it firmly to its place.

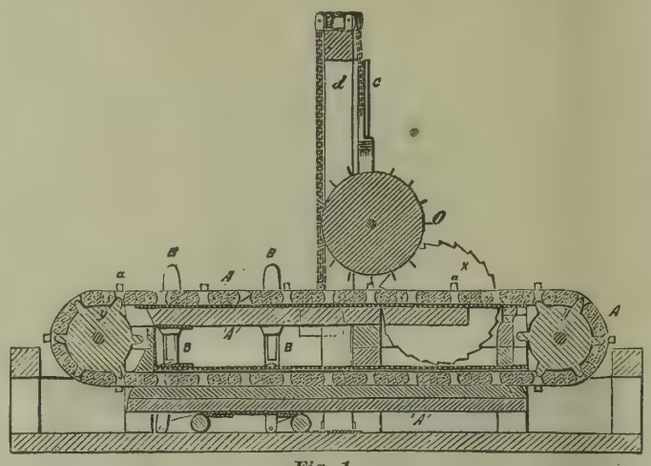


Fig. 1.

Figs. 2 and 3 represent an improved device for brazing band saws, invented by John F. Komp, of Chicago, Ill., the objects of which are, first, to confine the heat at the point where the saw is to be repaired, in a box, with a slot in which the two ends of the saw are inserted; second, to hold the two ends of the saw to be repaired in position by means of clamps and thumb-screws attached to a cast-iron box.

The perpendicular shaft or standard A, Fig. 2, supported at the base by legs or the plate *s* and cross-piece P, constitute the frame-work of the machine, the cross-piece P passing around the standard A, and being attached to it by a thumb-screw, so that it can be raised or lowered for the purpose of tightening the belts on wheels B, *d* and *e*. The wheel B on the cross-piece P being turned by the crank *b*, drives, with the belt on the pulley *c*, the wheel *d*, which in turn drives the pulley *e*, turning the fan in box *f*, thus making a blast through the tube or hose *g* at the nozzle *m*. On top of the standard A is placed the iron box K, and attached thereto by a screw passing through the box into the standard A, the box being divided into several compartments, all covered by the lid K′.

Fig. 3 is a detailed sectional view, in perspective of the box in which the heat is confined, and the clamps for holding the ends of the saw in position. Between the clamps a^2 a^2 is placed the box N, of cast iron, resting on the bottom of the box K, and not attached in any way, but fitting in between the two smaller compartments of box K, the box *n* having slot *n′* in front and open at the back, (see Fig. 2), and a block of common charcoal n^2, or other similar substance, inserted. The ends of the saw to be joined are brought together in the slot *n′* in the box *n*, and held in position by the clamps a^2 a^2. Just below the box K, on the standard A, is a bracket *i*, attached and held in position on the standard A by a sleeve en-

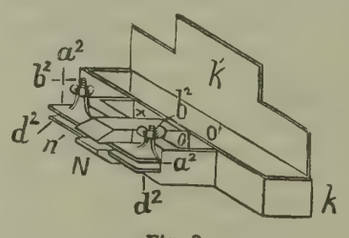


Fig. 3.

circling standard A, and a thumb-screw, on which is the lamp *h*, with the wick directly in front of the slot *n′* in box *n* (see Fig. 2), burning kerosene, alcohol or other similar substance. If desired, gas could be used instead of the lamp. The nozzle *m* on the tube or hose *g* passing over the lamp *h*, and attached to it, Fig. 2, the heat is forced by the blast into the slot *n′* in box *n*, and being confined there by the charcoal, an intense heat is brought upon the ends of the saw in slot *n′*, and the brazing is accomplished almost instantly. When the charcoal is consumed, or partially consumed, by repeatedly being used, the box *n* can be taken out and a new block of charcoal inserted.

The special novelty of the invention consists in providing means for maintaining the articles to be brazed in a proper relative position upon the bed plate of a charcoal receptacle *n*, whereby the articles to be brazed may be embedded in charcoal to co-operate with a flame in heating the soldering material.

Fig. 4 represents a novelty in the form of a nail-driving machine, the invention of John J. Burk, of Buffalo, N. Y., of which the cut shows a side elevation of the machine complete. As the detailed description would occupy too much of our space, we confine our references to it to the statement of the objects which it is claimed by the inventor to accomplish.

The object of the invention is to produce a reliable and rapid means for nailing hoops, boxes, etc., and clinching the nails when driven; and it consists of the following elements: First, an oscillating drum or box operated by connections with the foot-step, for holding the nails and dropping them

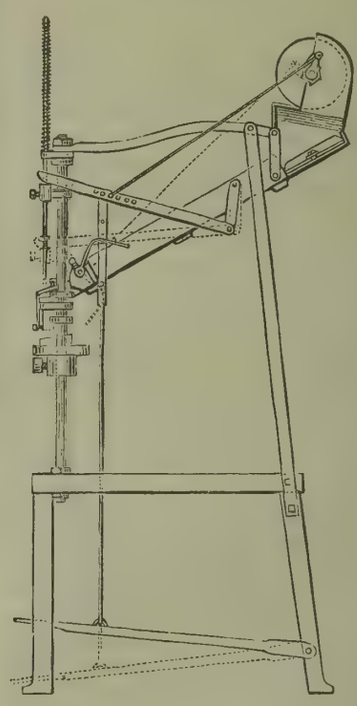


Fig. 4.

into the usual inclined guideways, in combination with a separating device, from which nails are delivered one at a time to the nail-receiving jaws; second, a nail-driving mechanism having an adjustable device for limiting its movement downward, in combination with a foot-step and its connections and operating mechanism; third, the nail receiving and guiding mechanism, whereby the nail is started into the wood before the lower jaws separate at the bottom, so that the end or point of the nail is guided to the exact point required, and is consequently always driven straight; fourth, an inclined vertically adjustable anvil, by which the point of the nail is turned and clinched across the grain of the wood when driven.

Figs. 5 and 6 represent certain improvements in cutters and plates for planing and molding machines, invented by Thomas Fitzsimmons, of Burlington, Vt. The objects sought to be attained by the inventor, are,

first, to provide a device by which the cutter may be readily attached to the cylinder without a possibility of displacement in the act of setting the same; second, to so arrange its attachment to the cylinder that it cannot yield to any obstruction which may arise in its operations; and, third, to afford facilities for keeping the cutter in line and clearing the groove at the side of the head, thereby leaving the bead always of a uniform size, and avoiding any liability of heating the cutters, and thus drawing their temper.

An inspection of the cuts in connection with the following description will show how these objects are accomplished. Fig. 5 is a perspective view of a side cutter blade and plate attached to the cylinder. Fig. 6 is a detailed view, in perspective, of a side cutter blade and plate. Views of center cutter and plate are not shown, as being unnecessary. A is a side cutter-blade, slotted at *a*, as is customary, to receive the bolt E, by which it and its plate B, are rigidly attached to the usual slotted square cylinder, G. Along the entire length of its lower face and parallel with the cutting-edge projects a lip, which is a continuation of the interior knife of the cutter-head, and is designed to fit into a corresponding groove in the upper face of the plate B, so that when in position the exterior edges of the cutter blade and plate shall correspond. The plate B, is of the same length, as well as width, of the cutter-blade A. On its under face is a transverse projection, *b*, of a width sufficient to closely fit into the upper part of the slot H, of the cylinder G. The two plates A and B are held together by a bolt, E, whose head is designed to fit into the lower and elongated portion of the slot H of the cylinder G. A nut, F, and washer serve to attach them rigidly to each other and to the cylinder G after the cutter is slid forward to its desired projection beyond the edge of the cylinder. In operation the head of the bolt E is slid into the slot H of the cylinder G. The bolt is then passed through a hole in the plates B or D, which brings their respective projections *b* or *d*, into the upper part of the slot H. The cutter is then placed upon its respective plate, its lip sliding into its corresponding groove. Then by screwing down the nut F and washer of the bolt E, which passes through the slot *a*, both the blade and plate become easily and rigidly attached to the cylinder G. To set the cutter no care is required to prevent its being turned or moved out of line of the cylinder, as would be necessary if it were directly attached to the cylinder in the ordinary manner, as its lip or lips, moving in the fixed grooves, a plate which is always kept in place by the projection on its under surface, retain it absolutely in place. For the same reason it cannot be displaced by any obstruction it may meet with in its working—a liability to which it is often subject when it is only held by the bolt. A great advantage also is found in the presence of the lip, which continually clears the groove of any fuzz or shavings along the side of the blade. This leaves the bead always of the same uniform size, keeps the cutters of the same shape, and effectually prevents their heating.

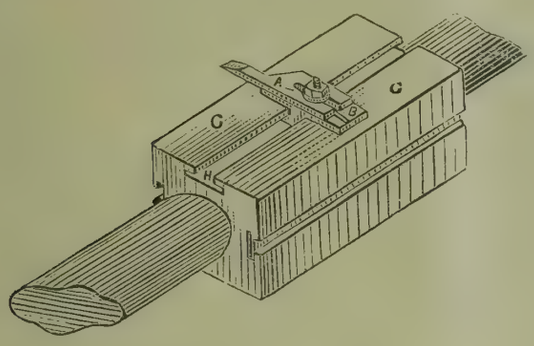


Fig. 5.

Figs. 7 and 8 represent a novel lathe attachment, invented by Henry Richmann, of San Francisco, Cal., and which is adapted to cut the teeth of gear-wheels, ratchet-teeth, spiral grooves for twist-drills, key-seats or ways in shafts, bolt-heads, nuts, and various kinds of irregular work which ordinarily require special and complicated apparatus.

It consists of a support which has a foot that may be clamped to the tool-rest of the lathe. This support is slotted to receive a bolt which holds an adjustable standard, through which the spindle passes which drives the various cutting-tools that are secured to it. The spindle is driven by gearing or pulley, or both. The belt from the pulley passes up over two pulleys, which are vertically adjustable, to allow the tool to move longitudinally upon the lathe-bed, and thence down to the main pulley in the head-block of the lathe, a counterbalance keeping up the tension.

Referring to the cuts, Fig. 7 shows a lathe armed with the attachment, and Fig. 8 a side view of the attachment. The device consists of a driving-spindle, J, the lower end of which is fitted to receive and hold any form of cutter which it may be desired to employ, such as are used in milling-machines and gear-cutters. This spindle is supported and turns in a sleeve or standard, K, and has a bevel-gear wheel, L, at its upper end. A swivel-arm, M, projects from this standard, and has a box, N, which supports a shaft at right angles with the tool-spindle. A bevel-gear, O, upon this shaft meshes with the gear-wheel L, to drive the tool-holder, and a pulley, P, upon its opposite end receives a driving-belt, which operates as will be hereinafter described. The arm M may be swiveled or turned around the tool-spindle as a center, so that the latter may be set at any desired point or angle with reference to the position of the driving-pulley, and it is fixed by a set-screw, Q. The angle at which the tool-spindle works is determined by fixing its standard to a permanent standard or support, R, by a nut and screw-bolt S′, which passes through a slot, T, in the support R. This support is firmly secured to the tool-rest. Disks *u v* lie between the support R and the standard, and when the nut S is loosened the stand, with its spindle, may be elevated or depressed through the slot, or it may be turned about the bolt as a center without altering its position vertically by loosening the nut S′. This independent movement is accomplished by forming the outer disk, *u*, with a projection which will fit the slot T without turning in it, while the continuation of said disk, which receives the nut S, is large enough to just pass through the slot. A hole is bored through this and the disk *u*, and a bolt from the disk *v* passes out through this hole and receives the nut S′. By this construction either adjustment may be made without disturbing the other.

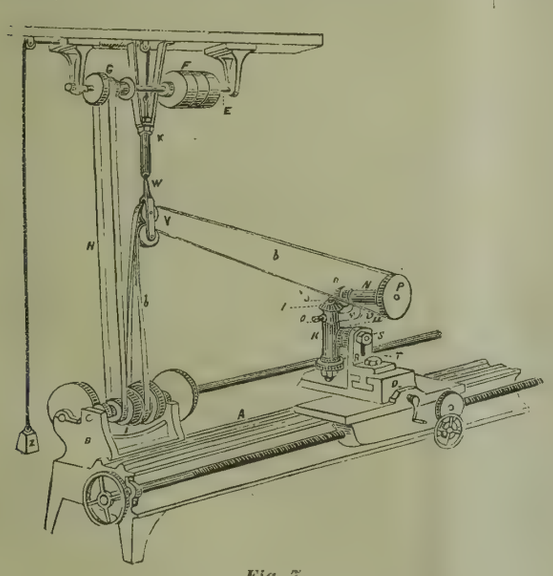


Fig. 7.

In order to drive this mechanism, and at the same time allow it to be moved longitudinally upon the lathe-bed without altering the tension of the driving-belt, an adjusting device consisting of a sliding bar, W, is provided, moving up and down through a guide or bracket X, and having the pulley Y at its lower end. The upper end is connected with a rope passing over pulleys, and having a counter weight or spring, Z, at its opposite end. The belt *b*, passes over the cone-pulley in the head-block of the lathe, and thence over the pulleys Y and down to the pulley P. By this construction it will be seen that the apparatus may be moved along the lathe-bed with the tool-rest, the sliding bar and the counter-balance keeping a proper tension upon the belt.

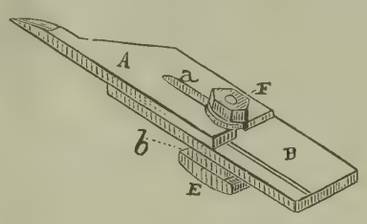


Fig. 6.

The gear-wheels L and O may be transposed to change the speed, or both may be removed and a pulley secured directly to the head of the tool-carrier for some classes of work. Key-seats may be cut of any desired length, depth, and width in shafts. Bolt-heads and nuts of any shape may be formed. Spiral grooves of any pitch may be cut in rods of steel for twist-drills or other purposes. Gear-teeth may be cut. Milling tools of all descriptions or emery-wheels may be attached and worked, this attachment serving all the purposes of the most expensive milling-machine.

Belting.

It is economy to put on a wide belt rather than make a narrow one too tight. Vertical belts should be drawn moderately tight.

Prof. J. Bauschinger publishes the result of a series of tests of the tensile strength of different sorts of belting made in the Mechano-Technical Laboratory at Munich. In making a graphic representation of the results by setting the loads per square inch on a horizontal line and erecting verticals corresponding to the elongations at the different loads, the curves thus obtained show considerable difference for leather, india rubber, and cotton belts. All these materials stretch more at first, with light loads, than afterwards. The lines, therefore, are more curved at the beginning, and afterwards approach more to a straight line. But with leather belts the approxima-

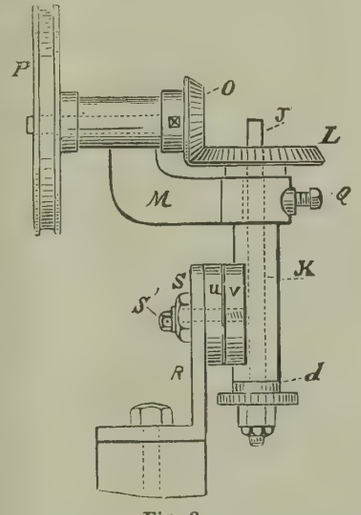


Fig. 8.

tion to a straight line begins at once, and is more pronounced than with india rubber or cotton belts, showing that they stretch in the beginning more in proportion to the load, and possess a high degree of elasticity. The conclusion drawn from the tests by Prof. Bauschinger is that india rubber and cotton belts are inferior to leather, not only as regards elasticity, but also as regards tensile strength, for the same section, and only attain in strength that of medium or inferior storts of leather. By cementing and sewing the ends, leather straps lose one-quarter to one-third of their strength, if the joints are not made with great care.

Building Intelligence.

Architects, Builders and Contractors are invited to send us items of interest for this department. It is our object to notice only the more important operations in building, our space being too limited for the publication of minor matters, which, besides, possess only local interest. We wish to publish only such intelligence as is of general interest.

New York City Building Items.

It is rumored that J. M. Mackay is to build a palatial residence on Fifth avenue, between Fifty-fourth and Fifty-fifth streets.

A panorama building is to be erected at the corner of Madison avenue and Fifty-ninth street by the Societe du Panorama National des Etates-Unis. The cost will be $40,000.

R. H. Robertson has made designs for a house for John J. McCook. It will be 30 feet wide and three stories high, of Belleville brown stone, the front of the first story being given up to one wide window 6 feet wide and a door 7 feet wide.

The Knickerbocker Club Building at Thirty-second Street and Fifth Avenue, is being remodeled by R. H. Robertson, while the rest of the plot will be built over, thus more than doubling the size of the former club house. A cafe 22 by 32 feet, a billiard room 27 feet by 36, a card room 17 feet by 40, and two large dining-rooms will be among the new apartments.

Plans have been filed by Nathaniel Witherill, of No. 58 Broadway, President of the Barrington Association, for the erection at Nos. 40 and 42 E. Twenty-fifth street, of a first-class apartment-house, to accommodate ten families, and to be known as the Barrington Flats. The structure which is to be of stone and brick with terra cotta trimmings, will be 50 feet front, 86 feet deep, and six stories high, with a deep basement and attic. The approximate cost is set down at $100,000. Carl Pfeiffer, No. 71 Broadway, is the architect.

The corporation of Trinity Church has entrusted to Charles C. Haight the work of erecting some model tenements upon its property at Hudson and Charlton streets. There are to be eighteen in all, each thirty feet wide, covering the whole front on Hudson Street, between Charlton and King streets, and running back 250 feet on each street. The buildings are to be five stories high, of brick and red sandstone, substantially finished. The apartments will contain from three to five rooms, besides a private water closet with a window in it. The stairs will be lighted by windows opening to the yard, and every known device to insure air, light, and good sanitary arrangements will be adopted. Four of these buildings—two on King Street and two on Charlton—are nearly finished.

Douglas Smyth is at work on the plans for the new Jefferson Market building. It will be about 100 by 100 feet, and be erected on the site of the present market. The building will be of brick, two stories high on Sixth avenue and Christopher street, running back about 25 feet, and in the second story there will be offices for lawyers. The interior of the market will be covered with a glass and iron roof, and the columns will also be of iron, while the floor will be covered with concrete and rock asphalt. Particular attention has also been given to the drainage and ventilation. The style of the structure will be English Gothic, so as to conform to that of the adjoining Court House. Work will commence about April 1st, and it is expected that the building will be completed in about five months, at a cost of $60,000.

Charles C. Haight has just finished plans for ten pavilions to be erected on Brothers' Island, near Port Morris, for patients suffering from smallpox and other infectious diseases. The first of these pavilions is now building. It will be 40 feet long by 160 feet wide, two stories high and essentially fire-proof. The arrangements for ventilation, disinfection, etc., will be very complete, with slate bathrooms and floors. There will be two wards on each floor—the upper floor for men, the lower for women. A glass "sun-room" at the southern end of the pavilion will be one of its features. Each pavilion will accommodate eighty patients.

R. H. Robertson has nearly completed for J. W. Alexander, of the Equitable Life Insurance Co., a house on the south side of Fifty-Fourth street, west of Fifth avenue, 38 ft. wide and 80 ft. deep. The style is Romanesque, an oriel bay window of stone projecting over the entrance. The material up to the second story is rock faced Carlisle (Scotland) sandstone and above that brick. The stone cornice is capped with a copper cresting. The front steps are at right angles with the house, and the railings and posts are of wrought iron in the old so-called colonial style, of which some excellent specimens may be seen in East Broadway, the posts forming cages of delicately wrought iron. The entrance hall is fourteen feet square with a fireplace. At the front of the house is a library nineteen feet wide by twenty-five feet long opened by folding doors into a dining-room of exactly the same size.

R. H. Robertson is completing for John Sloane a house on Fifth Avenue, between Seventieth and Seventy-first Streets, which will be one of the finest if not one of the largest houses, fronting the Park. The size of the house is 34 feet front by 118 feet deep. The style is a combination of Renaissance and Romanesque, with wide, round-arched windows, having the tympanum filled in with colored glass. The fourth story is a species of mansard roof, or, more properly, a hipped gable roof similar to that seen in some French chateaux. The material of the front is Belleville brown stone, an elaborately carved two-story projection, giving a bay window on the first and second floors, being one of the features of the front. At the side of the entrance hall, ten feet wide is a library 20 feet square, back of which is the main hall 18 feet wide and 30 feet deep wide, running across the whole house. An enormous fireplace for logs is at a south end of the hall, which is really one of the chief rooms of the house. Then comes a parlor 19 by 23; in the extension is a conservatory and smoking-room, and in the rear a dining-room 18 feet wide by 27 feet long.

In pursuance of Columbia College's plan of completing its quadrilateral of buildings Charles C. Haight has just finished designs for a new School of Mines to occupy the site of the present one. The new building will have a frontage of 120 feet on Fourth Avenue and an average depth of thirty-five feet. It will connect with the School of Mines lecture-room and library, built several years ago, and will complete the Fourth avenue front of the college in harmony with the fine west building on Madison Avenue, which forms the opposite side of the quadrilateral. It will be four stories high, with a well-lighted basement, which will be used for rough works in connection with the School of Mines, the Architectural Department, and the Chemical Department. The treatment of ore in quartz mills and furnaces, the building and tearing down of the walls, the treatment of machinery for boring, well-sinking, and such heavy work will be done here. On the first floor will be a chemical museum, a laboratory, lecture-room, and a private room for Professor Chandler. The second floor will be devoted to a mineralogical museum, blow-pipe laboratory, metallurgical museum, and a lecture-room for Professor Egleston. The third floor will be given up to the new department of architecture, and will comprise a drawing-room, architectural library, lecture-room and the professor's room. On the fourth floor will be Professor Trowbridge's (engineering) lecture-room, with drawing rooms, a lecture room for Professor Newberry (geology), and a museum for the late Professor Torrey's fine herbarium. The building will be of brick and fire-proof throughout, the front being of brick with red sandstone trimmings.

Miscellaneous.

James Hunter & Son, of North Adams, Mass., have decided to erect a new factory.

An Episcopal chapel is being erected at Dillon, Montana Territory, from designs of Ion Lewis and Henry Payson Clark, architects, of Boston, Mass.

Contracts are being made for the erection of an oat-meal mill, 30 by 50 feet, four-story brick, for Farley & Christie, at the corner of Seventh and White streets, Dubuque, Iowa.

A brownstone church with a seating capacity of 650, and to cost about $20,000, is being built at South Orange, N. J., from designs of Rossiter & Wright, of New York.

A party of New York capitalists have purchased a tract of land, about 830 acres, at Lawrence, near Rockaway, L. I,, and propose to lay it out and build commodious cottages.

At Irvington, N. Y., a memorial chapel, to seat 150 people, is to be built of native granite, at a cost of about $12,000 from designs of Rossiter & Wright, of New York.

James Sillie, of Kankakee, Ill., has taken the contract to build the stone Presbyterian Church in that city, in accordance with the plans of J. R. Willet, architect, of Chicago.

Plans are being prepared for a "Library Building," for the Young Men's Christian Association at Buffalo, N. Y. The building is to be fire-proof, and situated at the junction of Pearl, Mohawk and Genesee streets.

At Hillsdale, Mich., a two-story brick memorial chapel for the First Presbyterian Church, measuring 26 by 52 feet, is to be built on the rear, and adjoining the church edifice at a cost of $2,500. N. B. Bacon is the architect, and G. M. Troy, Hillsdale, the contractor; work to begin as early as the weather permits.

Allen & Kenway, of Boston, Mass., are preparing plans for a large stone house to be built for Rufus Hatch, of New York, on the Bermuda Islands. It will be two-and-three-story, covering about 6,000 square feet. The great hall will be full hight of building, with open timber roof.

A portion of the Lawrence Farm, two miles west of Long Branch, N. J., has been purchased by Rufus W. Leavitt for himself, Robert B. Minturn, and other gentlemen, who intend building cottages for their own occupancy. The stockholders will have erected at once a building 50 by 80 feet on an island in the vicinity, which will be used as an apartment house during the building of their cottages.

The Pueblo Building and Investment Company, of Pueblo, Col., have let contracts for the erection of a first-class hotel at that place. It will be situated on the corner of Santa Fe avenue and Eighth street, and is to be finished about the 1st of September next. The dimensions are 130 feet on Santa Fe avenue, 120 feet on Eighth street, four stories. It is to be faced with pressed brick, with sandstone finish; W. W. Boyington, architect, of Chicago; C. A. Jordan, superintendent, of Chicago. The cost of the building will be $140,000.

W. W. Larmour, of Waco, Tex., has been awarded contracts for the erection of the following buildings at that place: A hotel, of 45 rooms, for Trav. F. Jones, to cost $26,000; a building 90x100 feet, for Wm. Cameron, as a wholesale grocery, to cost $18,000; a building 20x83 feet, to be used by Lessing, Solomon & Co. as a wholesale dry goods house, to cost $22,000; also a public school at Corsicana, Tex., to cost $21,000. All these buildings are now in course of erection.

New Planing, Matching and Beading Machine.

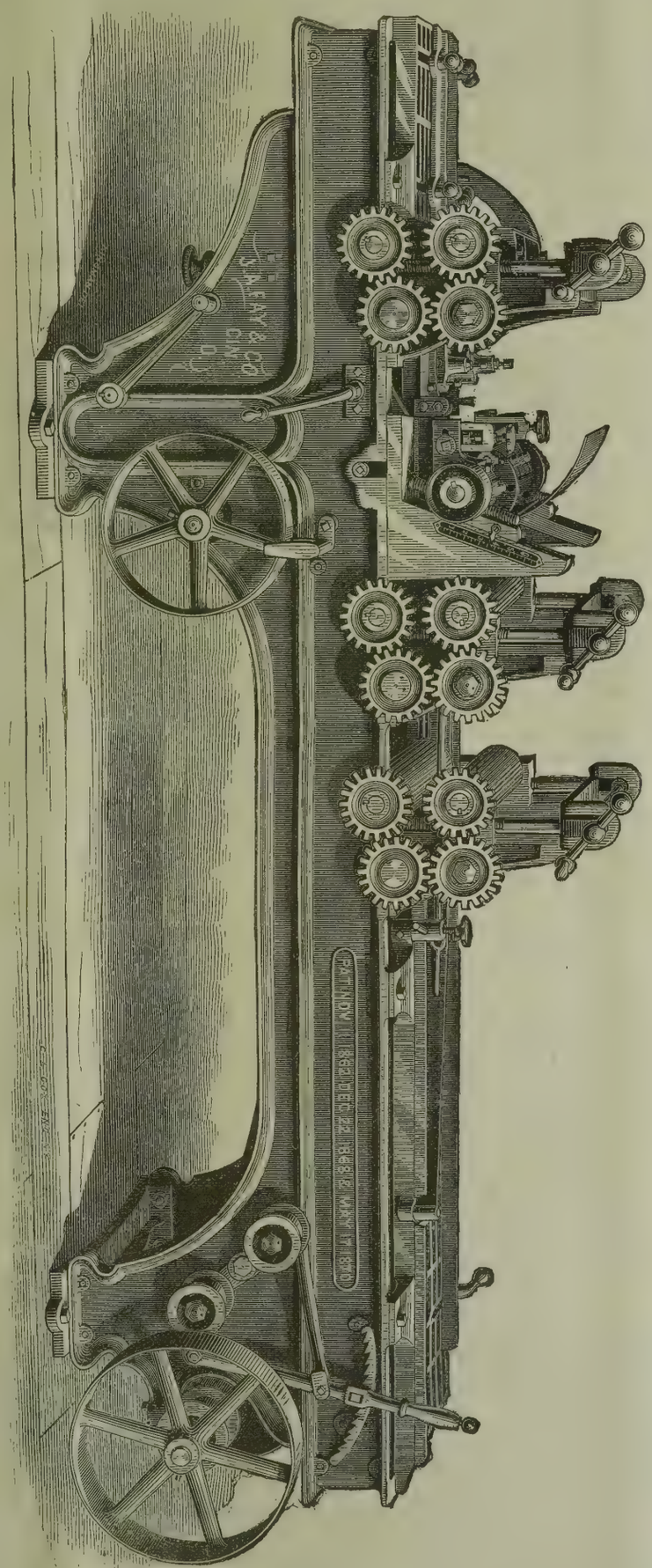
The machine illustrated herewith, from the products of the extensive establishment of Messrs. J. A. Fay & Co., of Cincinnati, O., is designated in their catalogue as the No. 2½ Pacific patent planing, matching and beading machine. It is designed for certain special uses, for which it has come to be looked upon as standard. It will surface up to 24 inches wide and 6 inches thick, and tongue and groove to 14 inches wide. It is adapted also for working special classes of moldings. It is made with either one or two cylinders, and with four or six rollers, as may be desired. The cylinders are of wrought iron, with heavy steel journals, and slotted on all four sides for the accommodation of different lengths of knives, and have pulleys for two driving belts. The matcher heads are of gun metal, fitted with steel set-screws, and run upon heavy steel arbors, which are adjustable laterally by means of a screw, and are also instantly dropped below the line of the bed without removal of the matcher heads or clip when it is desired to surface 24 inches wide.

Both matcher heads being adjustable across the machine, distribute the friction of the lumber on the bed plate, and prevent unevenness of wear. The rollers are large in diameter, driven by heavy expansion gearing, which will open to 8 inches. They are heavily weighted, and flexible to accommodate any inequalities in the lumber. The feed of the machine is very powerful, the rollers being large, and the belting, gearing and weighting being so proportioned as to allow no slipping. The cylinder for top planing is carried in heavy boxes, planed to fit to stands cast solid to a bed, extending across the machine. The pressure bar before the cutter is arranged to swing from the cylinder, so that there is always a pressure close to the knife, which prevents tearing out.

The pressure bar, both before and after the top cut, is adjustable to and from the cylinder to make room for the projection of molding, rustic or drop siding cutters. The lower cylinder, on the double machine, has its bearings in a connected frame cast in one piece, adjusted vertically by two screws operated by connecting gearing. It is slotted on all four sides, has large steel arbors, and pulleys for two driving belts. The pressure bar over this lower cylinder can be raised to the full thickness of the stuff that can be worked on the machine. The cylinder is easy of access, and the bars can be adjusted to or from the cut.

The plate under the upper cylinder can be removed for re-planing or renewal when worn out of line. The matcher clip, an important improved feature, is adapted to this machine, and in such a position that a deep rabbet can be made for drop siding. It is furnished with the double belt tightener devised and employed by this firm, patent solid milled cutters, improved tight and loose pulleys, and pulleys for changes of feed. Bearings are arranged with large oil cavities to insure perfect lubrication, and the best material and workmanship enter into its construction.

Further particulars respecting this machine can be obtained by addressing the manufacturers, Messrs. J. A. Fay & Co., Cincinnati, O.



J. A. FAY & CO.'S IMPROVED PLANING, MATCHING AND BEADING MACHINE.

An Elastic Lacquer.

A patent has been taken out in Germany for a new description of elastic and flexible lacquer, which will not peel off, and which is suitable for the coating of carriage cloths, plans, and other articles to be folded up, as well as for wood and iron work, walls, etc., but which may also be employed as an insolating layer for damp rooms as a means against dry rot, and in rendering stuffs water-proof.

To produce the lacquer, 50 kilogrammes of linseed oil varnish are heated up to boiling point. In another vessel about 15 kilogrammes of lime are slaked in 20 kilogrammes of water. As soon as the lime boils, about 50 kilogrammes of hot melted caoutchouc are added to the lime water, and the whole is then stirred until it has become thoroughly mixed. This composition is poured into the boiling varnish, the whole being stirred all the time. Further stirring takes place until a homogeneous mass is formed, which is afterward strained or filtered, and left to cool. After cooling, the lacquer has a pap-like consistency.

To apply the lacquer it is diluted with the desired quantity of varnish, and put on with a brush, either in a warm or cold state; but it is said to be better to apply it warm, as then no varnish is required for diluting it. In rendering linen water-proof the lacquer may be put on by means of a brush or roller. After treatment, the linen or other stuffs, paper, etc., are hung up to dry. Stuffs are perfectly dry and ready for use in two days. The product is stated to be lustrous, elastic, not sticky, and perfectly water-proof.

India Rubber Varnish.

Dr. Elder gives the following recipe for making India rubber varnish:

Inclose 30 grams of finely cut caoutchouc in a capacious linen bag, and suspend this within a flask containing a liter of benzine, by means of a thread held fast by the stopper, so that the bag remains near the surface of the liquid. In the course of six or eight days, the soluble portion of the caoutchouc—about 40 to 60 per cent—will pass into the benzine, while the contents of the bag will expand enormously. The clear solution, which is quite viscous, and contains 1.2 to 1.5 per cent of caoutchouc, is then carefully separated. The swelled contents of the bag retain one-fourth to one-third of the benzine used, and may be utilized for the preparation of an inferior kind of varnish.

A solution of India rubber in benzine, kept in half-full bottles, is decomposed on exposure to light, which may be seen by the change in the solution from a viscous to a thin fluid condition. Even in the dark this change goes on, but it takes about three times as long.

Explosion of a Battery of Boilers.

We give in what follows an interesting and instructive report, with proper illustrations, of the causes leading to the destructive explosion of a battery of ten boilers, which occurred a few minutes before 5 o'clock on Sunday morning, November 13, 1881, at the salt and lumber manufactory of Hamilton, McClure & Co., situated on the Saginaw river, in the town of Zilwaukee, Mich. The report was prepared by Mr. F. B. Allen, one of the special agents of the Hartford Steam Boiler Inspection and Insurance Co. It is as follows:

The ten boilers were of the horizontal tubular pattern, in a one-story boiler house, apart from the other buildings. No. 1 boiler was set singly; next to that a battery of four, Nos. 2, 3, 4 and 5; a second battery contained five, Nos. 6, 7, 8, 9 and 10; each battery having but one furnace for all, with suitable fire doors for each boiler. Each of these boilers were 50 inches in diameter by 21 feet long, of five-16ths iron originally, but since considerably thinned in places, and single riveted. The single boiler was 56 inches in diameter by 13 feet long, and five-16ths iron.

These boilers were arranged to feed in each battery through a 2½-inch feed pipe, which delivered its water into two 16-inch heaters, set in the upper part of the back connection, extending transversely across the boilers, and supported at the ends by the outside walls of each battery. From the heaters, the feed passed into the mud drum, situated beneath the boilers in the usual way, and connected to them by ample sized nozzles.

When under steam, the feed-water, after its passage through the heaters and mud drum, entered the boilers at a high temperature. Both an injector and pump were used for the purpose, and the feed supply seemed abundant. Above the boilers there was a steam drum with 10-inch nozzles connecting each boiler of the battery; on this drum there was one common lever safety valve, (see Figs. 1 and 2).

The boilers were run day and night under a steam pressure of from 50 to 90 pounds; at night they were under the charge of a head fireman, with instructions to call the engineer, who lived conveniently by, if his presence was needed. He was believed to be a very trustworthy man, of whom his employers and associates spoke in the highest terms. There was a steam gauge, also a water gauge glass, on each battery; the intermediate boiler had one gauge cock, which seemed to have been from one inch below to three inches above the tubes on different boilers. It did not appear to me the fireman could rely on the gauge cocks, but would depend on the glass water gauge—an excellent auxiliary in the hands of a capable engineer, who verifies its indications by trying the cocks. It may be a source of danger to others if too implicitly relied upon.

A majority of these boilers were originally of the two-flue variety, with 30-inch domes. The flues were cut out and tubes put in some years ago by former owners. The present owners had some additional tubes put in certain boilers, and supposed all were put in thorough repair at that time—some eighteen months before the explosion. With perhaps two exceptions, these boilers were 15 or 16 years old, covered by numerous patches, thinned down in spots by corrosion, and badly crystallized, as shown by the granular edges of the ruptured plate.

I was informed by the management that there was a standing order that all boilers should be thoroughly cleaned out once a month. Besides that, they were filled up and blown down (part way) under pressure several times every Sunday. The river water used for feeding the boilers was very muddy, and formed a troublesome deposit of sediment on the shells and

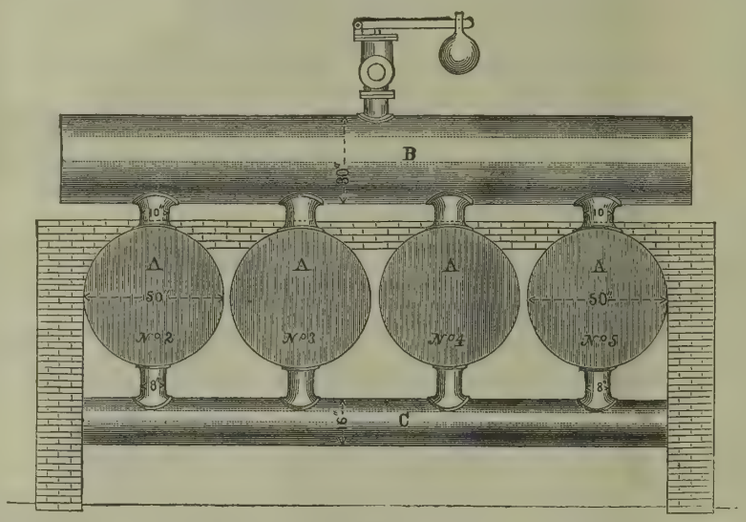


Fig. 1.

tubes if these precautions were not observed. The addition of the upper row of tubes considerably lessened the steam room, thereby increasing the danger from foaming, while the neglect to change the gauge cocks, in all cases to conform to the altered tube level, made their indications deceptive, as in Fig. 3, and the use of such boilers attended with great danger.

With our present knowledge of boiler construction, sheets of five-16ths-inch iron, single riveted, for a boiler 50 inches in diameter, with the pressure required, and for the service intended, would be considered rather light. The shells, too, were dangerously cut away in putting in the man-hole mouth-pieces, the longitudinal openings of which were 18 inches across the grain, instead of girthwise. Among the wrecked fragments of the seven badly shattered boilers, I counted several that ruptured through the line of the weak man-hole opening. After the lapse of so many years, with the usage to which these boilers had been subjected, we may prudently assume that the tensile strength of the iron did not exceed 42,000 pounds, and I believe it would have been considerably less than that, remembering that parts of the shell had been reduced by corrosion, and other causes incidental to their use, so that it callipered but one-quarter of an inch. We have approximately

$$\frac{42000\times.25}{25}=\frac{420}{6}=70$$ pounds as their safe working pressure, while the actual working pressure, as testified by the engineer before the coroner's inquest, was that they "carried from 40 to 80 pounds of steam during the season, and sometimes, when the mill shut down, it would run up to 90 pounds before it could be controlled."

With the exception of No. 1 boiler, these boilers were suspended by a 1⅛ inch hanger bolted to a cross-beam above in the usual way, and also by stands under the shell at the front and back ends (see Fig. 2). It is not known what condition those supports were in, nor whether the load was properly distributed; the enormous weight of the boilers, steam drum, pipe attachments and fittings, brick covering, mud drums, etc., with the contained water, must in the aggregate have exceeded 52 tons in the battery of four boilers (Fig. 1), and would, if properly distributed, have seriously endangered their safety. Many explosions of late years have been attributed to that cause. All the suspended weight on the cross-beam was sustained by the two side walls, the condition of which could not be determined at the time of my visit, after the wreck had been cleared up and the work of rebuilding commenced.

There were three safety valves for the ten boilers; No. 1 had a separate valve on top of the steam dome, with a free escape into the fire-room. The battery composed of Nos. 2, 3, 4 and 5 had one 7-inch valve on top of the steam drum; the escape from this valve was through a *3½-inch pipe to the salt block.* (Figs. 1 and 2). According to the regulation of the United States Steamboat Inspection Service, which bases the safety valve area upon the heating surface of the boiler, this, though not absolutely correct, is, with the data available to an inspector, a very handy method for obtaining approximately the required area. Assuming two-thirds of the shell and three-fourths of the tubes as effective heating surface, gives 972.29 square feet in each boiler, using the rule quoted, H. S. $\frac{}{25}$ we have $\frac{972.29}{25}=38.88$ sq. in. area, or about 7 inches diameter of safety valve. How nearly they complied with this rule will be apparent in the fact as demonstrated, that the battery of four boilers was dependent on a safety valve having an outlet of but 9.62 square inches. It may be doubted, however, if the use of a 7-inch safety valve would have been advisable in this case, particularly in view of the limited steam space and tendency to foam. Good authorities favor the application of two smaller valves to obtain the requisite area as affording greater security than one valve of large diameter.

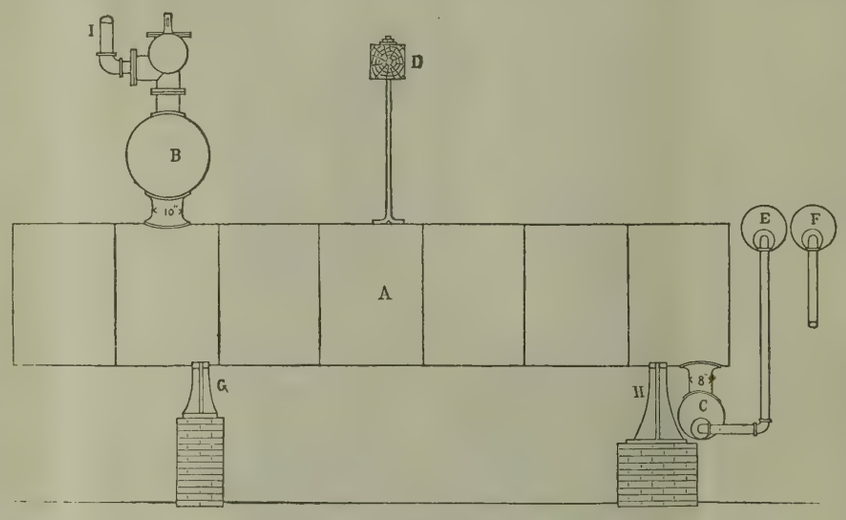


Fig 2.

The other battery of five boilers—Nos. 6, 7, 8, 9 and 10—had a 6-inch safety valve for all, connected to the steam drum, same as the battery shown in Fig. 1, but it was better connected, the escape pipe to the salt block being the same size. It was the custom, I was informed, to have two weights on the safety valve lever during the day, one of which *should have been removed at night and the remaining weight shifted in*, so as to blow off at about 40 pounds. The fireman had been detected in moving out the weights

during the night, so they might accumulate pressure while the fires were at their best. The watchman saw 65 pounds on the steam gauge an hour before the explosion, which would indicate that they were violating orders when they met their deaths. The fuel used—wood slabs—when dry, make an intense heat. The habit of the fireman is to fill up the furnaces from grate to boiler bottom, and rest as long as possible between times. The watchman on his last visit to the fire-room but ten minutes before the explosion, noticed the men at their work; he engaged in conversation with them; everything, so far as he could see and judge from their actions, was about as usual; they had just put in their last fire, and, as he expressed it, "It was a big one."

The immediate cause of explosion, and point of initial rupture, I find myself unable to decide. It may have been due, I think, to any one of several causes which I find existed, and from which these boilers were liable to explode at any moment, or possibly a combination of these several predisposing causes, namely:

1. Weakness of the boilers. Primarily that of construction, but increased by long service under the unfavorable conditions of high pressure, bad water, and lack of skillful supervision.

2. Insufficient number and arrangement of safety valves, to permit the free discharge of steam generated in the boilers, which, should the steam outlets be suddenly closed, would permit a dangerous accumulation of pressure until explosion occurred, which pressure in all probability would not greatly have exceeded the working pressure.

3. Danger from over-heating and rupture of the exposed shell along the fire line, owing to the false position of the gauge cocks.

4. Danger from foaming, through lack of necessary steam space, consequent upon the addition of the top row of tubes. This danger was further increased by the unavoidable use of muddy feed-water.

5. Possibility that the boilers might have been strained on the girth and horizontal seams, by the shifting of the supports (assuming they were properly placed at first), and unequal distribution of the load, in which case they (the boilers) might break in two. This would be most likely to occur when they were pumped up to an unusual hight, as they are believed to have been on the morning of the explosion, preparatory to blowing down when the engineer came on duty.

Could I have reached the scene of the disaster immediately after the explosion, or even before the wreck had been cleared up, important corroborative evidence might have been obtained that would have assisted in solving the problem.

I think the explosion occurred in the battery of four boilers (Fig. 1), for the destruction was the most complete there. Absence of water and red-hot boilers were the causes assigned by the coroner's inquest; but unprejudiced men, if they have experience in such matters, will look long, and, if I mistake not, fruitlessly, for indications of low water in this explosion. One of the gentlemen who testified at the inquest and attributed low water as the cause, when requested to point to some evidence of it, very frankly said his only reason for thinking low water the cause, was because he had always heard that given as the cause of explosion, and knew of no other. A casual inspection of the arrangement of the heaters and mud drums will show that when the boilers were fired up, as they were at the time, it would be impossible to feed cold water, for the feed would have to traverse two heaters, each about 20 feet long, and thence into the mud drum, before it entered the boilers at a temperature nearly as high as the steam.

That ten boilers should have exploded simultaneously, seemed an unfathomable mystery. Really but nine exploded, for No. 10 boiler was only thrown out by the force of the explosion. We do not know that nine boilers exploded simultaneously, for it was testified before the inquest by one of the workmen, that two detonations occurred in rapid succession. In that case the second explosion would be due to the concussive jar of the first. The setting of these boilers, and size of the steam and water connections, *made each battery practically one boiler* with an enormous destructive energy in the event of explosion.

In conclusion, I attribute the violence of this explosion to the liberation at the time of rupture, of the mechanical energy of a large mass of water at a high pressure, and its instantaneous vaporization at atmospheric pressure.

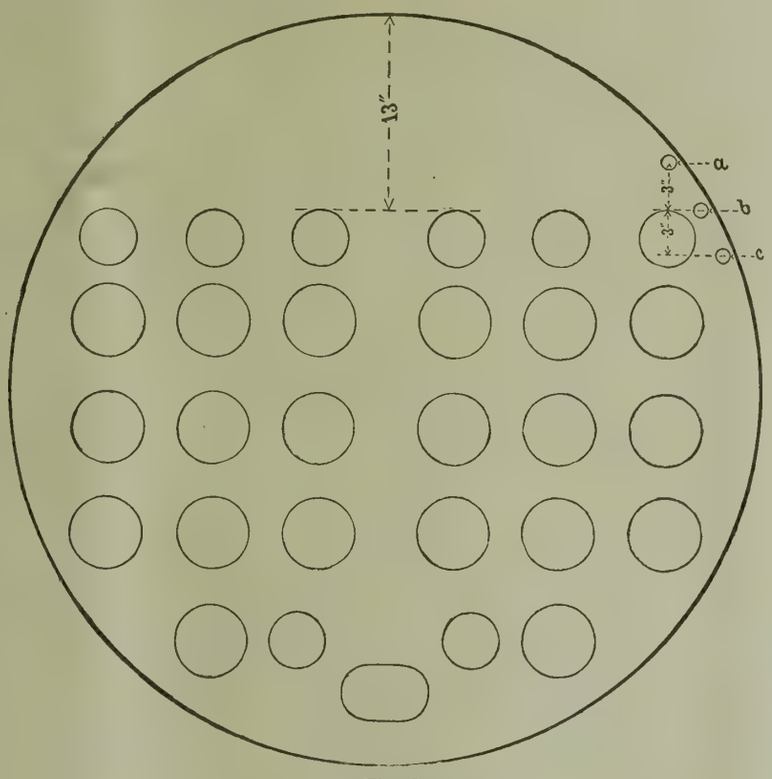


Fig. 3.

Action of Hydraulic Cements upon Embedded Metals.

John C. Trautwine, C.E., in a communication to the *Railroad Gazette*, says:

"The fact that this important subject has of late been brought somewhat prominently before the notice of civil engineers and builders, induces me to send you the results of ten years' trial by myself. The hydraulic cements used were English, Portland and Louisville (Kentucky), besides which I tried plaster of Paris, both pure and mixed, with equal measures of the cements. All were of about the consistency of common mortar; and all were kept in an upper room during the ten years, unexposed to moisture other than that of the in-door atmosphere.

"The metals were partly embedded in the pastes and partly projecting from them. They consisted of cut iron nails (some of which were galvanized), smooth iron wire nails, brass in both sheet and wire, zinc in sheet, copper wire, and solid cylinders of lead three-eighths of an inch in diameter.

"The result at the end of ten years was that all the metals in both of the neat cements, were *absolutely unchanged;* and the same was the case with those in the plaster of Paris, with the exception of the ungalvanized nails, which had become covered with a thin coat of rust; as were also those in the mixtures of plaster and cement, but to a less degree.

"This experience leads to the inference (already suggested by others) that moisture or dampness is the injurious agent in those cases of corrosion of iron and lead laid in cement, that have lately appeared in the journals; and that if dampness can be absolutely excluded, both cement and lime mortar will probably protect from injury all the metals employed in ordinary constructions, for an indefinite time.

"Such entire exclusion of dampness may at times be somewhat difficult of attainment, for capillary attraction alone (unaided by hydrostatic pressure) will cause water to rise several inches in well hardened cement; and it would be difficult to assign limits to its penetration when aided by a high head of water. Rain water is well known to percolate through many feet in depth of brick-work or masonry laid in lime mortar, even when it consists partly of cement."

The Brooklyn Bridge.

Mr. W. A. Roebling, Chief Engineer of the Brooklyn Bridge, states in a recent report, in giving a detailed account of what has been done to strengthen the superstructure, that the aggregate strength of the wire composing each of the four cables, has been estimated to be 12,300 tons (of 2,000 pounds) and the elastic limit two-thirds of that amount—namely, 8,200 tons. From all the tests made, the average strength of all the wires was not placed too high. The method of splicing the wires was such that the full strength of the wire was maintained at all points. The superstructure consists essentially of the floor system and stiffening trusses. One of the most serious difficulties to be contended with in this structure is the maintenance of the balance of spans arising from the exceptional length of the land spans.

Mr. Roebling gives the total weight of the bridge, including the transitory load, as 17,780 tons, from anchorage to anchorage—3,460 feet. Mr. Roebling adds: "It being the wish of the board, as shown by the resolution annexed to the report of the committee, of which Mr. Kinsella was chairman, on the 6th of May, 1878, that the bridge should be adequate to the passage of the Pullman car, it became incumbent upon me to provide the necessary truss power with which to transfer the concentrated loads and to check the increased deformation of the cables resulting therefrom." He explains in great detail what he has accomplished, and finishes the report with the words: "The cables are strong enough to pull up the two anchorages."

New Method of Heating Railway Cars.

The method proposed by M. Ancelin for heating railway cars, namely, by the use of acetate of soda in the foot-warmers, seems to have proved very satisfactory on some of the French lines. As is well known, the substance thus employed has considerable latent heat; dissolved at a certain temperature, it absorbs a large quantity of heat, which becomes sensible during crystallization in cooling. All that is required is to fill the ordinary cases with a sufficient quantity of the acetate, close them, and place them in a stove at about 100°. The cooling of the case thus charged and heated takes twelve to fifteen hours. The warmers thereafter are taken from the compartments and placed in a stove—where the crystals of soda acetate are redissolved—and are then ready for fresh use.

The Signal Service and its Methods.

It is now nearly fifty years since Prof. Espy, the "Storm King," as he was popularly known to our fathers, conceived the idea of enlarging and extending the scope of the study of atmospheric changes—the origin, nature and course of storms and the like, by making provision for the conduct of *simultaneous* meteorological observations by a large body of trained observers, operating upon a uniform system over an extended area of the country. To this end, he endeavored at that early day to enlist the co-operation of Congress to further his plans, but without success. He did, however, succeed in securing the assistance of the State of Pennsylvania, which granted a considerable sum of money for the purpose of establishing meteorological stations in every county of the State. The working out of the details of the plan was placed in charge of the American Philosophical Society and the Franklin Institute. Intelligent men were selected in each county to make daily record of meteorological facts, and to report the same to the societies above named; and for this purpose they were provided with a standard barometer, thermometer, wet bulb and other necessary apparatus, at the cost of the State. This method of observation was continued for a number of years, until the organization by Prof. Henry of a meteorological bureau in connection with the Smithsonian Institution. The great facilities of this establishment enabled the lamented originator of the project to organize a plan of meteorological observations to cover a large section of the country, and with the introduction and rapid growth of the electric telegraph, which occurred about the same time, the effectiveness of the system was greatly increased. In consequence, the earlier effort we have named, was gradually abandoned, and many of the Pennsylvania observers who continued their work, reported their results to the Smithsonian Institution.

The Smithsonian observations were continued with much success for twenty years or more, and during the later years the idea of establishing a weather service for the public benefit, was developed, and gradually assumed definite form, until it was crystallized in the establishment of the Signal Service under government auspices. Under the direction of Gen. Myer, to whom belongs the chief credit of having organized the machinery of this bureau, the Signal Service became a most efficient institution. Its stations are scattered all over the country; its trained officers, with the aid of the telegraph, are in constant communication with the central establishment; weather maps, showing the atmospheric conditions existing over the entire country, are daily displayed and distributed from every station; forecasts of the weather for every section for twenty-four hours in advance are made daily and given the widest publicity, and navigators are advised by signals displayed from stations at the harbors and seaports, whether to stay in port or whether they may proceed to sea in safety. So efficient, indeed, has this organization become, and so reliable its methods, that foreign governments have not been slow in modeling their own weather service after the American pattern, and the praise that has been bestowed upon it by meteorologists the world over has been unstinted and deserved. It would be impossible to make an estimate of the annual value of the Signal Service to the agriculturists and the commercial interests of the country; but it is no exaggeration to place it at millions of dollars annually, and in this estimate we do not consider the vast public convenience subserved by the daily publication of the "probabilities" throughout the country.

As many of our readers will be interested in learning something of the methods by which the Signal Service accomplishes its important work, we propose to give in this and succeeding numbers a series of articles descriptive of its working plans, which we trust will be found both interesting and instructive.

Each observer of the Signal Service, when ordered to establish a new station, has instructions to secure a room for office purposes, and for the storage of his instruments and the other government property in his charge. The room must be in the immediate vicinity of the telegraph office charged with the receipt and transmission of the weather reports, and it is in all cases desired that it should be in the upper story of the building, and that it should contain at least *one* window facing the north. In all cases he is directed to obtain permission to occupy the roof of this building for the necessary exposure of his instruments, and, at stations specially designated by the chief signal officer, for the erection of an instrument shelter, after the plans approved by the service.

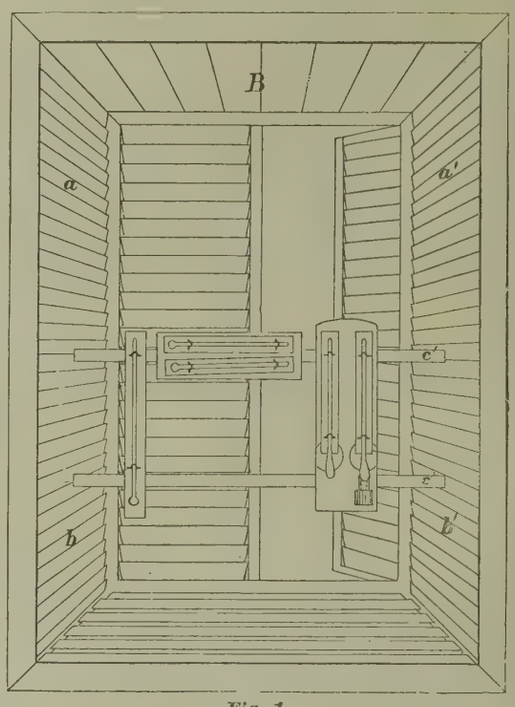


Fig. 1.

Where permission to occupy the roof for exposure of instruments cannot be had, or a suitable roof cannot be found, the observer is directed to construct his instrument shelter substantially as shown in Fig. 1, and which may be described as follows; He selects a window fronting the north, removes the lattice blinds if there be any, and along the exterior jambs of the window he places perpendicularly two pieces of lattice-work ($a\ b, a'\ b'$) projecting to a distance of from 20 to 24 inches from the panes. Midway between the window and the outer wall of the shelter, and at the hight of the eye of the observer, he passes from one end of the shelter to the other two small wooden traverse bars $c\ c'$, each an inch square, for the purpose of supporting the instruments, exposed thermometer on the left, maximum and minimum thermometers in the center, and wet-bulb thermometer on the right. The blinds that were removed from the jambs, or others provided for the purpose, are hinged to the side walls, so as to be opened when necessary, and secured in the middle by an ordinary staple and hook. Ten inches outside of this frame work, a second wall, also of lattice-work, is placed, with the front opening in the center, in the same manner as the inner wall. The whole is then covered with an inclined roof of boards *B*, placed at least 15 or 20 inches above the instruments. The bottom of the shelter is covered with slats 2 inches wide, placed 1 inch apart. The outside of the shelter is painted with white lead. It is preferred that the building selected for the uses of observers should be detached from other buildings, or, where this is impossible, that it should be higher than those surrounding it, to protect the instruments from local influences.

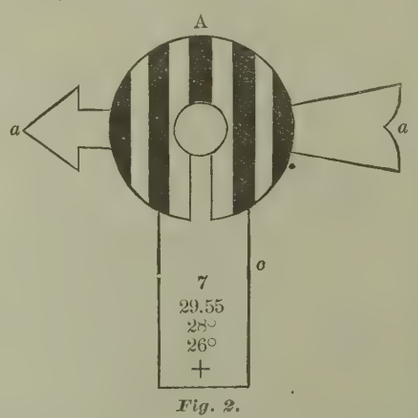


Fig. 2.

So soon as a new station is opened, the observer is directed to put himself as soon as practicable in communication with the Board of Trade, Chamber of Commerce, Board of Fire Underwriters, or such other bodies as may be interested in promoting the usefulness of the local office. He is directed also to open communication with colleges, scientific bodies, and the like, where any such institutions may exist in his neighborhood, and to invite their co-operation in adding to the usefulness of his work.

Each observer is required to take five complete observations, and a sunset observation, daily. These are recorded in a book called the "Original Record of Observations," and in another called the "Monthly Meteorological Report." The telegraphic series of observations which are called for daily, several times by telegraph, from the central office, comprise a corrected barometer reading, temperature, dew point, direction of wind, and state of weather; velocity of wind in miles per hour; maximum velocity of wind in miles per hour since last telegraphic observation; upper clouds, lower clouds, and the reading of the maximum thermometer. These dispatches are sent in a cipher adopted and used by the service. The greatest importance is attached to the prompt transmission of these reports, and observers are held to strict accountability for any neglect of their duties in this respect. Reports must be made on Sundays at the regular hours, and punctually delivered at the telegraph office.

When the morning reports are received from the central office, the observer is directed to translate them into ordinary language and write them out clearly and plainly. Copies of the bulletin must be placed in the rooms of the Board of Trade, Chamber of Commerce, and such other conspicuous places as may be designated. A copy of the bulletin will be furnished to each newspaper published at the station, provided its regular publication can be secured. Certain stations are provided with manifold maps, and they are prepared daily from the bulletins as received.

The "War Department Weather Map" is changed in accordance with the following key and instructions: The index consists of an arrow, disk and card, which show the direction and velocity of the wind, state of the weather, hight of the barometer, hight of thermometer, dew point, and sunset prediction of the previous day at the place at which they are affixed. The index will be changed once daily at 10 A.M., or as near that time as is practicable. The arrow flies with the wind. A red disk indicates clear weather; a $\frac{1}{4}$ blue disk, sky $\frac{1}{4}$ covered with clouds; a $\frac{1}{2}$ blue disk, sky $\frac{1}{2}$ covered with clouds; a $\frac{3}{4}$ blue disk, sky $\frac{3}{4}$ covered with clouds; a blue disk, sky covered with clouds; a black disk, rain; a white and black-board disk, snow, hail or sleet; a white (reverse side) disk, foggy weather; a square symbol, red with black center, indicates the display of the cautionary signal; a square symbol divided into equal horizontal sections, the upper section white and the lower red, the section having a common square center of black, indicates the display of the off-shore or northwest signal. The other data, hight of barometer, thermometer, etc, are writted upon a silicate tag and attached to

the disk. The character of sunset of the preceding day is indicated on the map by a cross made at the bottom of the tag. A red cross shows that the sunset indicates fair weather for the succeeding day; a blue cross, foul weather; red and blue, doubtful.

When the symbols are changed, a clean set of tags is substituted, and those removed are cleaned with a sponge for future use.

Fig. 2 will serve to illustrate the use of the symbols. The barred disk *A* indicates snow (see *ante*), and the position of the arrow *a a'* that the wind is blowing from the east. The upper figure on the card *c* shows that the wind is blowing with a velocity of 7 miles per hour. The figure next below, the hight of the barometer reduced to sea level; next comes the hight of the thermometer above zero; and last the dew point. The cross below all, indicates the sunset prediction, and its character will be recognized by its color or colors. A calm is indicated by the omission of the arrow, as shown in Fig. 3.

Observers are held responsible for the direct publication of all weather reports at their respective stations, and are required to take every precaution to guard against errors.

Instruments.—The instructions to observers respecting the instruments to be employed, and their care and use, will be found useful for reference. Each station of the first class is provided with the following instruments: Two mercurial barometers, two exposed thermometers, two wet-bulb thermometers, two maximum thermometers, two minimum thermometers, two anemometers, and one self-registering attachment, two wind vanes (large and small), one rain gauge, one clock, and other instruments may be added from time to time as the necessity for their use becomes apparent.

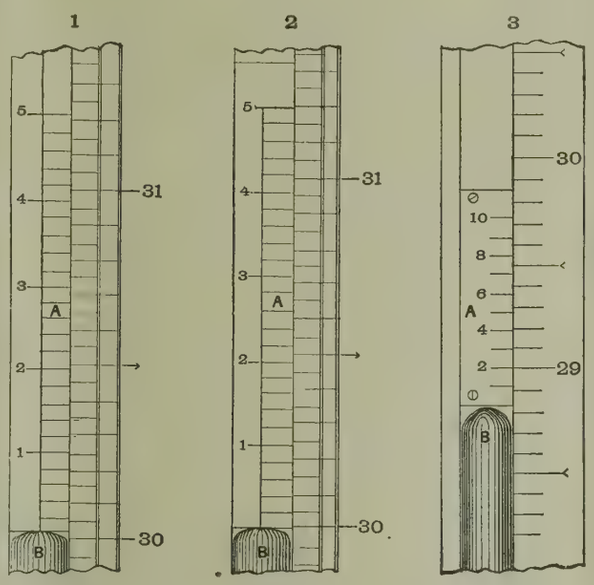
The Barometer.—The barometers used on signal stations are in every case carefully compared with the standard at the central office before being issued, and the corrections for each instrument (and attached thermometer) are sent with each when issued. On the last two days of every month observers are required to compare their barometers by a series of readings of not less than ten in number, five being made daily at hourly intervals, and no change of instrumental error may be made without authority from the central office. The barometer must be suspended so that the top of the mercury column will be about on a level with the eye, near a window, in such a manner as to be lighted perfectly without exposure either to the direct rays of the sun or to the currents of air which are always found at window casings and doors. To protect the instrument from external injuries, from dust, and from the direct radiation of warm bodies, or currents of air from the window, observers are directed to fasten the under case in which it is carried firmly against the wall in a vertical position. An opening large enough to admit the tube of the barometer must be cut in the upper end of the box, and directly above this, at the distance of one inch, a strong hook must be driven into the wall. This hook must be small enough to allow the barometer to swing freely upon it, and to hang in a perfectly vertical position, and should extend two or three inches beyond the box, and upon it the instrument is suspended. When not in use the cover is to be kept closed, but when an observation is to be taken, the box is opened and the instrument is drawn out on the hook clear of the box, and in the full light of the window. The instrument is afterwards returned to the box and the latter closed.

The observer is required to correct his barometer readings for temperature, for instrumental error, and for elevation. For the first correction the attached thermometer is used, and in correcting for elevation the proper constant furnished by the central office is used, a table for which purpose is supplied.

In moving a barometer, even across a room, the office directions are that it should be screwed up and carried with the cistern uppermost; and minute instructions are given as to the manner of caring for it when traveling. When required for use, it must be gently inverted, hung up and unscrewed. While it has the cistern uppermost, the tube is full—is one solid mass of metal and glass, and not easily injured; but when hung up a sudden jolt might send a bubble of air into the vacuum at the upper end of the tube, which would render it useless until repaired. Observers are particularly cautioned against swinging the barometer, or against endeavoring to force the mercury against the top of the tube, without first screwing up the large adjusting screw at the base of the cistern.

Fig. 3.

The following directions for cleaning the instrument will be found useful to those who are interested in the use and care of barometers: If the cistern should become dirty, it can be cleaned with safety and without changing the zero of the instrument. Everything used in the operation must be clean and dry. Blowing upon any of the parts must be avoided, as the moisture from the breath is injurious. The instrument being placed vertically, the cistern uppermost, unscrew and take off the brass casing which encloses the wooden and leathern part of the cistern. This wooden part (which has the grain crosswise, and therefore is not air-tight) is made in two pieces, fastened together by four screws and four brass pieces. It will be necessary to take out two of these screws and loosen the other two, when the brass pieces can be taken off. The upper wooden piece, to which the bag is attached, can then be lifted off, and the mercury will be exposed. By then inclining the instrument a little, a portion of the mercury in the cistern may be poured out into a clean vessel at hand to receive it, when the end of the tube will be uncovered. This is to be closed by the *gloved hand*, when the instrument can be inverted, the cistern emptied, and the tube brought again to its vertical position. Care must be taken to prevent any mercury from passing out of the tube. The long screws which fasten the glass portion of the cistern to the other parts can then be taken off, the various parts wiped with a clean cloth or handkerchief, and restored to their former positions. The mercury which has been taken out of the cistern must now be cleaned, or replaced by other that is clean and pure. If the old mercury is merely dusty, or dimmed by a film of oxide, the cleaning may be effected by straining it through chamois leather, or through a funnel with a capillary hole at the end, of a size to admit of the passage of but a small thread of the metal. Such a funnel is conveniently made of letter-paper. The dust will adhere to the skin or paper, and the filtered mercury will present a clean and bright appearance. At stations where muriatic acid can be procured, the mercury may be easily and quickly cleaned by mixing with it about two ounces of the acid in a small vessel or cup, and then pouring into the vessel clear water until it overflows and carries off all the impurities. When sufficiently pure, the water must be poured off, and the mercury heated over a gas or lamp light until all remaining moisture is expelled. If chemically impure, it should be rejected, and fresh, clean mercury used. With such clean mercury, the cistern must be filled as nearly full as possible, the wooden portions put together and securely fastened by the screws and clamps, the casing screwed on, and the screw at its end screwed up. The instrument can then be hung up and readjusted. If a little mercury has been lost during the operation, and there is none at hand to replace it, no serious harm has been done; but if much is lost, fresh mercury must be added to prevent the open end of the tube from becoming exposed when inverting the instrument. Should any air have entered the tube during the operation of cleaning, efforts should be made to expel it by screwing the mercury into the tube, then inverting the instrument, loosening the screw, and gently tapping the top against the shoe. Observers are directed, however, not to undertake the cleaning or repairing of their station barometers without first receiving permission to do so from the central office, unless the work appears to be absolutely necessary. When done, the fact is required to be reported, with the number of the instrument, and the record of a full series of comparative readings taken immediately before and immediately after the cleaning.



30.011. 29.999. 28.822.

Fig. 4.—Standard. Standard. Station.

To Read the Barometer.—A piece of white paper is placed in the box behind the tube to reflect the light and to aid in setting the vernier accurately. To make a reading, it is directed as follows: 1st. Read the attached thermometer to the nearest half degree. 2d. Adjust the surface of the mercury in the cistern carefully to the ivory point or zero of the scale. When the mercury is quite pure, the proper adjustment can be easily made by causing the actual point of the zero pin to coincide exactly with its reflected image in the mercury below; but when the mercury is covered with a slight film of oxide, it is necessary to determine the contact by immersing the point in the mercury first and then slowly lowering the screw until the depression disappears. 3d. Tap the barrel of the barmometer firmly, to free the mercury from the sides of the tube and readjust the zero of the scale. 4th. Bring the lower edges of the vernier to the column of mercury so that they exactly coincide with the top of the meniscus or curvature of the column without cutting off any of the light at the angles, as shown in Fig. 4, where A represents the vernier and B the column of mercury. At night a lamp is used to throw the light on the paper. 5th. The inches and tenths are then read from the scale, and the hundredths and thousandths from the vernier.

[*To be Continued.*]

Invention of the Screw Propeller.—Leonardo da Vinci appears to have applied the screw propeller at the end of the fifteenth century to aerial locomotion. The uncovering of the monument to Sauvage, who is believed to have been the first who practically applied the screw propeller to the driving of ships through the water, has given rise to a discussion of the true history of the propeller. The *Comptes Rendus* gives Leonardo's screw as applied by him to aerial navigation.

Silk Culture in the United States.

Mr. Lorin Blodgett, the eminent statistician and editor of the *Textile Record*, at the last meeting of the Franklin Institute, delivered a very interesting address upon the progress of silk culture in this country, with especial reference to the work accomplished by the Women's Silk Culture Association of the United States.

Mr. Blodgett said that the manufacturing interest had grown to vast proportions, chiefly by the introduction of improved machinery. He exhibited specimens of silk grown and reeled here, and, comparing it with some of the finest silk produced in Italy, declared the American silk to be superior. He said that he had no doubt that improvements in the raising of silk-worms and the reeling of silk would enable America to compete in that industry with Europe and the East, and, as if in confirmation of his remarks, Dr. Wahl, the editor of this journal, and the secretary of the Institute, exhibited an iron frame American silk reel, built by Mr. Bilgram, on which twice as much silk could be reeled in a day as on the rude reels ordinarily used. It has no special features except mechanical excellence in construction to give it this advantage. Mr. Blodgett denied specifically, and in detail, an assertion made by the Paterson (N. J.) *Guardian*, that the American silk intended to be made into a dress for Mrs. Garfield was inferior to the foreign article, and that the country had to be scoured to find enough material for it. He said there was enough American silk to make fifty dresses, and that the amount grown could be multiplied indefinitely and as rapidly as facilities for reeling it could be provided; and that he could demonstrate its superiority to that sent from Italy as the best product of that country.

The "osage orange," a common tree throughout the country, was reported to be excellently adapted for the feeding of the silk-worm.

The Uses of Camphor.—We conclude, with the following, Mr. G. F. Bihn's interesting paper on camphor, an instalment of which appeared in our last issue. The present portion of the article relates specially to the uses of this substance:

The major portion of camphor is consumed in its well known application as a protector against moths, and other destructive insects. Its use in medicine is limited; to some extent, however, it is applied as a rubefacient in combination with alcohol and ammonia, or dissolved in chloroform; and similarly in an alcoholic soap solution. As a sedative, or pain-stilling agent, it is sometimes employed together with opium for sudden seizures of cramp, and the like. In the United States, however, it has found considerable use as a therapeutic agent in combination with bromine.

Another application of camphor, in combination with nitro-glycerine, as an explosive, promises to become of some importance, provided that the volatility of the camphor does not operate as a disadvantage, which fact can only be learned in practice. It is employed for this purpose in the following manner: If to a mixture of 90 parts by weight of nitro-glycerine and 10 parts of soluble nitro-cellulose, 4 parts of camphor are added, there results a gelatinous, elastic, transparent mass, of a yellowish color, which is flexible and sufficiently solid to be cut with a knife. This jelly-like mass may be subjected to a pressure of 20,000 pounds to the square inch without yielding up its nitro-glycerine. It may also be moderately warmed without sensibly softening. It is known as "explosive gelatine" (*Spreng-gelatine*), and was first prepared by Nobel, the well-known Swedish technologist, who invented dynamite.

Explosive gelatine, prepared with 10 per cent of camphor, may be heated to a temperature of 70° C. (=158° Fah.) without exploding, and without showing the slightest signs of decomposition. It is indifferent to an eminent degree to severe blows, on which account it may be subjected to the roughest usage in handling and transportation without danger; even the discharge of a rifle ball into a mass of it, at the distance of 30 yards, fails to explode it. It is indifferent to, and non-absorbent of, water, and can therefore be safely stored under water to avoid any possible danger.

The new explosive is so difficult to set off, that the exploders commonly used with gun-cotton and dynamite will not answer satisfactorily for the purpose, and exploders prepared with extra powerful fulminates must be used instead. The explosive force of the new material considerably surpasses that of the best gun-cotton or dynamite. [This statement we give on Mr. Bihn's authority, but it may be found to need qualification.—*Ed. M. & B.*]

An industry that is as yet comparatively young—viz., the manufacture of celluloid, already consumes considerable quantities of camphor. The snowy camphor obtained in the manner described in our previous article appears to be best adapted for the production of this material.

The method of procedure in its manufacture is substantially as follows: The new material, wood fiber, cotton wool, linen, etc., are dried at 100° C. (=212° Fah.), finely ground, and nitrated by treatment with a mixture of concentrated sulphuric and nitric acids (saltpeter may be substituted for the latter), after the manner followed in making soluble or collodion cotton for photographers' use. When the cellulose has been sufficiently nitrated, it is removed, as much of the acid pressed out of it as possible, and repeatedly washed with water. To remove the last portions of acid from the mass, which adhere to it obstinately, a little ammonia or soda is added to the wash water, and this is followed again by repeated washings with water. After being again subjected to pressure to remove the bulk of the water, the nitro-cellulose is intimately mixed with camphor, in the proportion of 100 parts of nitro-cellulose to 40 or 50 parts of camphor, and the mixture is pressed into thin disks, which are thoroughly dried by piling with alternate layers of absorbent paper. When thoroughly dried, the disks are then introduced into a steam-jacketed press, where the material is subjected to an elevated temperature (say about 150° C.=300° Fah.) and powerful pressure, when the solvent action of the liquefied camphor on the gun-cotton effects its conversion into the homogeneous horn-like substance known as celluloid. The material is now ready for a variety of uses, and is either fashioned directly into various useful or decorative objects in molds, or otherwise treated. Where a colored or mottled product is desired, the colors are introduced into the mixture of camphor and pyroxyline before the conversion into celluloid takes place.

Mr. Gerner, of New York, has proposed the use of camphor as an addition to rubber and gutta-percha before vulcanization. According to him, a mixture of equal parts of camphor, rubber and sulphur, heated to about say 150° C. (=300° Fah.), yields a very durable and elastic product. Very fine varnishes, that can be colored to suit any requirement, are made by dissolving nitro-cellulose in camphor and carbon disulphide.

Killed by Electricity.—The following paragraph relating to a fatal accident that lately occurred in Pittsburgh, Pa., at one of the largest iron mills in that city, emphasizes better than whole pages of description the reality of the dangers of the electric light, and the necessity of surrounding its use with better precautions and safeguards to render human life and property safe. The paragraph is given below as it appears in the daily papers:

"A singular and fatal accident occurred at Carnegie & Co.'s Union Iron Mills, on Thirty-third street. In the mill there is an electric battery [dynamo machine.—*Ed. M. & B.*] of sufficient power to run the sixteen lights necessary to illuminate the premises. Some trouble has been experienced in the past with boys working in the mill who persisted in making dangerous experiments with the generating engine. In order to stop this practice, a fence about 4 feet high had been built completely around the engine and a special watchman employed to keep the boys away from it. About half-past 1 o'clock in the morning, Henry Balzer, a workman in the plate mill, took a lantern in his hand and went over to a clock hanging near the electric machine, to see what time it was. After ascertaining the hour he walked to the machine and stood leaning upon the fence around it. The facts just at this point could not be clearly learned, but from statements made by persons connected with the mill, it appears that Robert Lyon, the engineer, in connection with some experiments he had been making, had stretched a wire from the battery to one of the other wires and along the top of the fence. While Balzer was leaning upon this fence, he suddenly turned around, smiled and ejaculating 'Oh!' dropped into the arms of Lyon, expiring immediately. It is supposed that while leaning upon the fence he had touched the wire with his damp and empty hand, thus forming a circuit, the current passing through his body and into the ground. A livid mark around the throat and a long furrow running from the thigh of the left limb to the ankle showed the course taken by the electricity. Otherwise Balzer looked as if he had fallen into a deep sleep."

The precise manner in which this accident occurred does not appear to have been ascertained; but from the foregoing statement of facts, it is clear that the unfortunate man succeeded in some way in short-circuiting the current of the machine with his body, either by making accidental contact with his body with the two wires carrying and returning the current, or, what appears more probable as the story is told, he may have accidentally touched one of the main wires of the circuit, and his body completed a "short circuit" through the damp earth to the extra wire spoken of, which may have touched the ground at some point. Though it may not actually have been in contact with the ground, and only on the fence spoken of, this may have been wet, and thus formed a sufficiently good ground connection, when the other wire was touched, to carry off a fatal portion of the current through the unfortunate man.

Sea Bathing, says Dr. Amat, has proved of great benefit in many cases of disease of the eye. The improvement appears to be due to two causes: 1. The influence which such a course has upon the general health by curing anæmia and elevating the tone of the system, since sea-bathing is in the highest degree a restorative. 2. Sea-water, and occasionally also the atmosphere of the sea, has a local irritant action which should be watched, since it is most serviceable when there is a chronic, torpid, and indolent inflammation, while it is exceedingly dangerous when the inflammation is of an acute kind.

The Driving Power of Belts.—At the last meeting of the Franklin Institute, Mr. Robert Grimshaw read an interesting paper on the driving power of belts and the method of determining this value. He gave, in the course of his remarks, an outline of the results of a year's investigation of the driving power of belts, in which time he had made over 900 tests. He explained that the transmission of power by pulleys and flat belts depends on the diameter, material, condition and amount of the crown of the pulley; the arc of the contact on the pulley, and the kind, condition, width, thickness and tension of the belt. Each of these elements has a certain influence, modified, and, in some cases, neutralized or reversed by the others. Large pulley diameter is in all cases advantageous, especially with stiff and wide belts and light

tension. Increase of power is not proportionate to increase in tension, and there is a point in many cases, and perhaps in all, where further increase of tension produces no further increase in driving power.

Mr. Grimshaw illustrated his remarks by some practical tests, carried out with a testing apparatus devised and employed by him for making determination of the driving power of belts. The apparatus consisted of 18 and 36 inch iron pulleys, and a 36-inch wooden pulley, on which rubber and leather belts were tested under dead weight tensions of 28, 50 and 75 lbs. per inch of width, adhesion in this case being registered on a Fairbanks' traction dynamometer. This testing machine has an appliance for varying the arc of contact, and has ten pulley changes and ten belt changes. The variations of tension are practically infinite. Mr. Grimshaw said that his tests confirmed or explained part of the tests and theories of Morin, Briggs and Towne; Cooper, and Webber, modify or flatly contradict some of them, and add very largely to the sum of knowledge of belt transmission.

An Accident with Hydrofluoric Acid.—One of the Boston medical journals gives a statement of Mr. Robbins, assistant in the laboratory of the Massachusetts Institute of Technology, respecting the dangerous severity of injuries to the skin by contact with hydrofluoric acid. As this acid is much used in the arts in etching glass, porcelain and the like, and often by persons who know little or nothing of its dangerous character, we think the record of Mr. Robbins' experience with it may serve a useful purpose in impressing the necessity of caution upon those who have occasion to use this energetic reagent:

Mr. Robbins having occasion to etch a hole through a piece of porcelain, made use of hydrofluoric acid, and to facilitate the process, used a piece of match that had been saturated with the acid. Noticing that his fingers were getting wet, he washed them and applied tallow. He held the match in his fingers the greater part of an hour and a half, and about the end of that period noticed a loss of sensitiveness in the end of the finger and thumb, and some pain. He again washed them, and applied dilute ammonia water; washed that off, and applied bicarbonate of soda. The pain increasing, he applied Carron liniment, the sensation being like that of a burn. This was about noon. The pain gradually increased, and in the evening he was obliged to consult a physician.

"At this time the ends of the finger were white and very hard—so hard, indeed, as to dull the scalpel with which he endeavored to cut away some of the skin. The action was still going on; and as the depth to which it had penetrated could not be determined, a dressing of cold cream was applied, and later vaseline was used; but neither seemed to allay the steady increase of the pain, which now most nearly resembled the sensation of a burn when held to the fire. The only relief obtained was by the application of cold, and this was only partial; and the only variation in it was from bad to worse, and at last it became the most severe pain I can imagine. It was not until 4 o'clock the next morning, and with the aid of one hundred and ten drops of laudanum, that I was enabled to obtain sufficient relief for a broken nap. The next day the pain had subsided, and the acid had penetrated quite a distance below the skin, rendering the flesh totally insensible and hard, having abstracted all the water from it. The other fingers were only slightly swollen, and the swelling did not extend back as far as the hand, showing that the blood was not poisoned at all. My usual good health was only temporarily and slightly impaired by the laudanum, but no other medicine was given.

"The course of treatment was to remove the destroyed tissue. This it was thought best not to do with the knife, but poultices, alternating with frequent soakings in very hot water, were constantly employed, which proved effectual, although slow, in their operation, it being fully twenty days from the time of the injury till the slough was all removed. It was very dry and tough, and by no means inclined to separate from the surrounding tissues. In four weeks I abandoned all dressings to the fingers, and was enabled to use them a little. Only a small permanent loss of tissue has resulted, but now, after three months, the scars are tender and the sensation is perhaps permanently destroyed. This agrees with the action of this acid as stated by Wurtz, especially as regards the pain; but he does not mention the very important fact that no pain is felt for some time after contact with the acid, which in my case was between one and one and a half hours, and by this time the surface has become so hard that it is difficult, if not impossible, to check the action underneath, so that the damage is for the most part done before one finds it out.

"The difficulty in healing appears to consist in removing the slough, as it heals very quickly when this is out of the way; and after the first siege of pain, which is a long and severe one, the sore is no more painful than any other of equal size. I think that should I meet the same accident again, I should lose no time in washing it off as thoroughly as possible, and then apply water glass if this were accessible; if not, I should use an alkali, and, if possible, soak the part in water as hot as could be borne, and apply cold cream or some other dressing which would keep the part soft, and also exclude the air."

"Work" and "Energy."—Prof. Preece, in a recent lecture, thus clears up the definitions of "work" and "energy," which terms are often loosely used, and in such a manner as to confuse students:

"Suppose a gardener, with a ton of gravel in front of him, were told to move that gravel to a hight of three feet. He would go to work with his spade; he would move shovelful after shovelful from the ground-line up to the three-foot hight, and after he had moved the whole of it you might readily imagine that he would be a little fatigued. Now, whenever a person does anything which causes a little fatigue, he does what we call work. The gardener, in lifting the gravel, would perform an amount of work which is capable of being measured. I will give you another illustration: Supposing some of you boys were put beside a pile of cricket-balls, and for a wager or prize you were called upon to throw the balls as fast and as far as you could. A good thrower would perhaps throw the first ball 80 yards, he would throw the second ball 75 yards, the third 70 yards, the fourth 65 yards, and so each ball that he threw would go a less and less distance, until he had no strength left, and he could throw no more balls. Now, that boy would have done work; something would have passed out of him into the balls; he has, as it were, passed something that belonged to him into the cricket-balls, and as a result he feels fatigue through the loss of this something. Take another illustration: Supposing two crews agree to row a race. They start full of life and full of energy; they pull with all their hearts and might, and arrive at the goal, in common language, thoroughly pumped out. Something has gone out of them into the boat. That which has gone out of the crew, and out of the boy who threw the cricket-balls, is what we call energy, and what they have done is to do work upon the boat. Another example is in the case of foot-ball: A boy kicks a foot-ball and makes a splendid goal. To do that he has sent something out of his body into the ball which hurtles through the air past the goal, and the game is won. In all these illustrations something is done which results in fatigue, work is performed and energy is lost; in fact, work done means energy applied, and energy applied means work done. As mental energy is our capacity for learning lessons, for going through examinations, and that kind of thing, so the energy of the kind I speak of is the capacity for doing absolute physical work. The generality of this energy is immense. It is a difficult thing to grasp the fact that there is something in existence that we cannot feel, that we cannot touch, and that we cannot see, but which gives us all the force and all the power we possess."

How to Apply the Soda Remedy in Burns and Scalds.—A writer communicates the following useful directions to a recent number of the *Popular Science Monthly:*

"It is now many years ago that the author of this paper, while engaged in some investigations as to the qualities and effects of the alkalies in inflammations of the skin, etc., was fortunate enough to discover that a saline lotion, or saturated solution of bicarbonated soda in either plain water or camphorated water, if applied speedily, or as soon as possible, to a burn or scalded part, was most effectual in immediately relieving the acute burning pain; and when the burn was only superficial, or not severe, removing all pain in the course of a very short time, having also the very great advantage of cleanliness, and, if applied at once, of preventing the usual consequences—a painful blistering of the skin, separation of the epidermis, and perhaps more or less of suppuration. For this purpose, all that is necessary is to cut a piece of lint, or old soft rag, or even thick blotting-paper, of a size sufficient to cover the burned or scalded parts, and to keep it constantly well wetted with the sodaic lotion so as to prevent its drying. By this means it usually happens that all pain ceases in from a quarter to half an hour, or even in much less time.

"When the main part of a limb, such as the hand and fore-arm, or the foot and leg, has been burned, it is best, when practicable, to plunge the part at once into a jug or pail, or other convenient vessel, filled with the soda lotion, and keep it there until the pain subsides; or the limb may be swathed or encircled with a surgeon's cotton bandage previously soaked in the saturated solution, and kept constantly wetted with it, the relief being usually immediate, provided the solution be saturated and cold.

"What is now usually sold as bicarbonate of soda is what I have commonly used and recommended; although this is well known to vary much in quality according to where it is manufactured, but it will be found to answer the purpose, although probably Howard's is most to be depended on, the common carbonate being too caustic. It is believed that a large proportion of medical practitioners are still unaware of the remarkable qualities of this easily applied remedy, which recommends itself for obvious reasons."

Sleep Inducing Powers of Ozone.—Prof. C. Binz, of Berlin, has lately published the results of a series of experiments with ozone, and announces that he has found this agent, when used in diluted form, to possess pronounced nerve depressing and sleep producing properties. The effects were first noticed upon animals, and were afterwards confirmed by experiments upon the human subject. The time required to produce a state of stupefaction or sleep, varied with the subject, from 6 to 16 minutes. Large and prolonged doses of the gas produced nausea, dizziness and strangulation; but the diluted agent could be breathed for half an hour without apparent harm. Although of no immediate practical value, Prof. Binz's observations are of interest as a new scientific fact.

An Interesting Archæological Discovery has been made in Sweden, in a tomb near the village of Dune, on the island of Gothland. Four silver vases were found bearing designs representing St. Olaf, the evangelist, the apostles, fantastic animals, and the lamb, with the banner bearing the Gothland arms. One of these bears an inscription, and they date from the fourteenth century. A larger one, also of silver, with ornaments of animals and plants, is credited to the twelfth century. Three others, older still, one of Oriental style, bearing a Runic inscription, seven silver spoons, three gold bracelets, rings, chains, and some precious stones were also found. The treasure was bought by the Stockholm Museum.

Scale.

Some little time ago, the *Mechanical Engineer* offered a prize for the best essay upon "Things Every Working Engineer Should Know," and from the prize essay, written by Mr. H. L. Stellwagen, we clip the following upon the matter of scale in boilers:

Most all water contains vegetable, earthy and solid matter in solution; those which occasion the greatest trouble are probably sulphate and carbonate of lime, oxide of iron, magnesia, alumina and silica, and are found in greater or less proportion in water of different localities. They are capable of being precipitated by heating water to a high temperature, as in the case of the steam boiler, when the precipitated salts settle, covering the tubes, sides and bottom of the boiler with a thin coating for each quantity of water heated, which, if not properly treated, will soon form into a hardened scale very difficult to remove. The best preventive of scale is probably a good filter heater, in which the feed-water can be raised to a temperature sufficiently high to deposit the matter held in solution, in the filter of the heater, before entering the boiler. A practice which facilitates the making or hardening of scale in boilers, is that of blowing out the water under a high pressure. The only time to open the blow-cock when under steam, is in the morning before starting the engine; a small percentage of sediment may then be blown out, but it should only be continued for a few moments at the farthest.

When the boiler is to be emptied, it should, if circumstances will allow, stand until the brick-work, water, etc., become quite cool, then the blow-cock can be opened, and while the water is running out, or immediately after it is out, take off the man-hole plate, and with a hose wash the sheets and tubes well while the sediment is still soft. With this treatment very little scale will adhere to the iron, but all that does should be dislodged as soon as possible, and on every occasion, by scaling bars, chisels and hammers. Any sediment which the washing fails to remove should be scraped out before refilling the boiler. In cases where blowing out is compulsory, it should be done with as low a pressure as practicable. Water should be run out whenever it shows signs of being dirty—about once in two weeks is sufficient, as there is no use of emptying the boiler of water which has made its deposit and is comparatively good, to replace it with that which contains matter in solution to form new scale.

The great objection to scale is, that, being a non-conductor of caloric, it prevents a large proportion of the heat of the furnace from entering the water, the heat escaping up the chimney, causing a waste of fuel and decreasing the evaporating power of the boiler. With a heavy deposit of scale there is great danger of the iron which is in contact with the fire becoming burned, as the scale interposes a barrier to the radiation of the heat, and separates the water from the iron.

The Ocean Carrying Trade of New York.—So far as the ocean carrying trade is concerned New York has ceased to be an American port. The statistics of the past year show that while British, Danish, Dutch, French, German, Italian, Norwegian, Portugese, Spanish, Swedish, and even Russian vessels divided among themselves some $8,000,000 of freights from grain alone, not a bushel of grain or a barrel of provisions went abroad from this harbor under the American flag. In 1880 there were seven nationalties that carried less than we did, but last year they all bounded ahead, and the stars and stripes were nowhere. The British, of course, got the lion's share of last year's business, their proportion of the grain freights amounting to 62 per cent of the total. The Norwegians are second on the list, although their trade is wholly in sail vessels.

Practical Devices.

Mr. Robert Grimshaw, of Philadelphia, has devised a handy little instrument (shown in Fig. 1) for practical draftsmen, in the shape of a "triangle," which is specially adapted for use where a number of cross

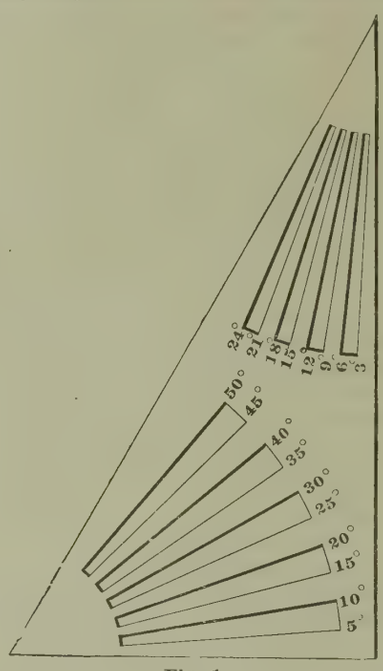


Fig. 1.

hatchings and section lines are required at distinct angles to prevent confusion. The usual rubber, metal or wooden triangle has in it several slots at varying angles, which are used for the different hatchings. A 60-degree triangle, with five radiating slots,

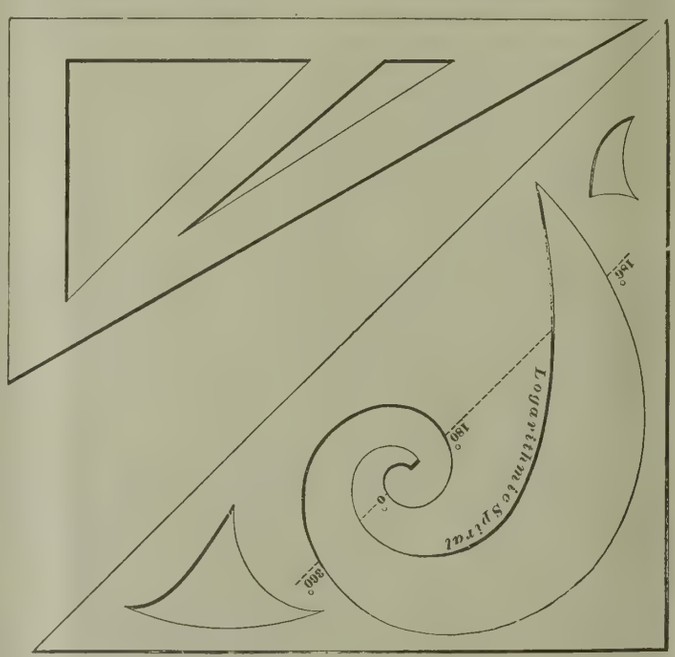


Fig. 2.—Logarithmic Spiral Curve.

gives twenty-four different angles of hatchings.

The same instrument is also handy for drawing conventional screw threads of various pitches.

Another triangle (shown in Fig. 2) devised by Mr. Grimshaw for his own use, contains a "logarithmic spiral curve," used as a fancy scroll for compound curves, and for making calculations.

The Coldest Place on the Earth is not, as has hitherto been believed by meteorologists, Yakutsk, in Siberia, but Verkoyansk, in the same region, lying in 67½° N. lat. on the river Yana. Its lowest mean winter temperature is 48.6° below zero Centigrade. This, then, is the cold pole of the earth in Asia; the corresponding pole in America being to the northwest of the Parry Islands; and the line joining these two places does not pass through the North Pole itself, which is thus, in all probability, outside the line of greatest cold. It is noteworthy that Verkoyansk, like Yakutsk, is on the main-land, a considerable distance from the Siberian coast, which possesses a comparatively milder climate. The recent Schwatka-Franklin search expedition, however, found that in the neighborhood of the Back River the mean winter temperature is not far behind that of Verkoyansk; of course the minima of both places reach a much lower figure. It is well known that in the tropics, on the other hand, the greatest heat is not at the equator, but some distance north and south of it.

Foreign Commerce.

The total value of the foreign commerce of the United States during the year ended June 30th, 1881, embracing both imports and exports of merchandise and specie, amounted to $1,675,024,318. The exports of merchandise from the United States, during the last fiscal year, amounted to $902,377,346. During each year from 1862 to 1879, inclusive, the exports of specie exceeded the imports thereof, but during the last two years the imports of specie have exceeded the exports thereof. This excess, during the last fiscal year, amounted to $91,168,650. The total value of the exports of domestic merchandise from the United States, during the last fiscal year, amounted to $883,-925,947. The value of the exports of breadstuffs amounted to $270,332,519; of cotton and manufactures, $261,267,133; of provisions, $151,528,368; of mineral oils, $40,315,609; of tobacco, $20,878,884; of wood and manufactures of wood, $16,608,767; and of live animals, $19,412,398. The total value of the imports of merchandise into the United States, during the last fiscal year, amounted to $642,664,628, of which the value of the imports of sugar and molasses amounted to $93,404,288. The value of the imports of coffee amounted to $56,784,391, or 8.84 per cent. The value of the imports of iron and steel, and manufactures thereof, amounted to $46,439,747, or 7.23 per cent. The value of the imports of silk, and manufactures thereof, amounted to $42,944,965, or 6.68 per cent. The value of the imports of wool, and manufactures thereof, amounted to $40,760,394, or 6.36 per cent. The value of the imports of chemicals, drugs, dyes and medicines, amounted to $39,590,473, or 5.69 per cent. And the value of the imports of cotton, and manufactures thereof, amounted to $31,-976,637, or 4.97 per cent. The total value of the imports of these seven commodities amounted to $349,000,895, and constituted 54.30 per cent of the total value of the imports of merchandise into the United States. The total value of the commerce of the United States with Great Britain and her colonial and other possessions, during the last fiscal year, amounted to $793,373,767, and constituted 51.35 per cent of the total value of the foreign commerce of the United States. During the fiscal year of 1881, the number of immigrants arrived in the United States was 669,431, and was larger than during any previous year. Of this number Germany contributed the largest portion, amounting to 153,718.

A New Speed Indicator, called the strathmograph, for indicating the speed of locomotives, has been introduced on the Hanoverian railroads. By it the engineer can read from a scale the actual speed of his engine at any time, besides which a record of the trip is kept on a strip of paper.

Market Report of Building Materials.

NEW YORK PRICES.

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LUMBER.

Pine, very choice and extra dry, ₱ M	$60 00@ 70 00
Pine, good	55 00@ 60 00
Pine, shipping box	21 00@ 22 50
Pine, common box	18 00@ 20 00
Pine, common box ⅝	16 00@ 18 00
Pine, tally plank, 1¼, 10 inch, dressed each	— 44@ — 50
Pine, tally plank, 1¼, 2d quality	— 35@ — 38
Pine, tally plank, 1¼, culls	— 28@ — 30
Pine, tally boards, dressed, good	— 30@ — 32
Pine, tally boards, dressed, common	— 25@ — 28
Pine, tally boards, culls, dressed	— 23@ — 25
Pine, strip boards, merchantable	— 18@ — 20
Pine, strip boards, clear	— 24@ — 26
Pine, strip plank, dressed, clear	— 33@ — 35
Spruce boards, dressed	— 25@ — 27
Spruce plank, 1¼ inch, dressed	— 28@ — 30
Spruce plank, 2 inch	— 43@ — 45
Spruce wall strips	— 15@ — 16
Spruce timber, ₱ M	20 00@ 25 00
Hemlock boards, ₱ M	17 00@ 18 00
Hemlock joist, 2½x4, each	— 16@ — 17
Hemlock joist, 3x4	— 18@ — 20
Hemlock joist, 4x6	— 40@ — 44
Ash, good, ₱ M	55 00@ — —
Oak	60 00@ 65 00
Maple culls	25 00@ 30 00
Maple good	45 00@ 50 00
Chestnut	48 00@ 52 00
Cypress, 1, 1½, 2, and 2½-inch	35 00@ 40 00
Black Walnut, good to choice	115 00@125 00
Black walnut, ⅝-inch	85 00@100 00
Black walnut, selected, and seasoned	150 00@175 00
Black walnut, counters, ₱ ft	— 22@ — 28
Cherry, wide, ₱ M	100 00@120 00
Cherry, ordinary	60 00@ 80 00
White wood, inch	45 00@ 50 00
White wood, ⅝-inch	35 00@ 40 00
White wood, ⅝ panels	45 00@ 50 00
Shingles, extra sawed pine, 18-inch	4 00@ 5 00
Shingles, clear sawed pine, 16-inch	3 75@ 4 00
Shingles, cypress, 24x6	18 00@ 20 00
Shingles, cypress, 20x6	10 00@ 12 00
Lath, Cargo rate	2 20@ 2 25
Yellow dressed pine flooring	30 00@ 40 00
Yellow pine girders	32 50@ 40 00
Locust posts, 8 feet, ₱ inch	— 18@ — 20
Locust posts, 10 feet	— 24@ — 25
Locust posts, 12 feet	— 29@ — 34
Chestnut posts, ₱ ft	— 3@ —3½
Basswood ₱ M	25 00@ 30 00

Cargo rates 10 ₱ cent off.

BRICKS.

	Cargo.	Afloat.
Pale, ₱ M	5 00 @ — —	
Up Rivers	— @ — —	
Jersey	8 50 @ 8 87½	
Haverstraw Bay	9 25 @ 9 37½	
" " choice	9 50 @ — —	
Favorite Brands	— @ —	
Hollow Fire-Clay Brick	9 00 @ 9 25	

FRONTS.

Croton—Brown, ₱ M	11 25 @ — —
" Dark	13 25 @ — —
" Red	13 25 @ — —
Philadelphia	35 00 @ — —
Trenton	35 00 @ — —
Baltimore	45 00 @ — —
Clark's Glens Falls, White	30 00 @ — —
" " Red Fronts	27 50 @ — —
" " Molded Red and White	45 00 @ 80 00

Yard prices 50 cents ₱ M higher, or with delivery added $2 ₱ M for hard and $3 ₱ M for front brick. For delivery add $5 on Philadelphia, Trenton and Glens Falls and $6 on Baltimore brick.

IRON—PER TON.

Duty.—Bar, 1 to 1½c. ₱ ℔. ; Railroad, 70c. ₱ 100 ℔. ; Boiler and Plate, 1½c. ₱ ℔. ; Sheet, Band, Hoop, and Scroll, 1¼ to 1¾c. ₱ ℔. ; Pig, $7 ₱ ton ; Polished Sheet, 3c. ₱ ℔. Galvanized, 2½c. ₱ ℔. ; Scrap cast, $6 ₱ ton ; Scrap Wrought, $8 ₱ ton—all less 10 ₱ cent. No Bar Iron to pay a less duty than 35 ₱ cent ad val.

Pig, Scotch—Coltness	26 50 @ 27 00
" Glengarnock	25 00 @ 25 25
" Eglinton	24 00 @ 24 50
" American, No. 1	26 00 @ 27 00
" American, No. 2	24 00 @ 25 00
" American forge	23 50 @ 24 00

LEAD—PER 100 POUNDS.

German	— — @ — —
English, common	— — @ — —
Spanish	5 75 @ — —
Foreign, refined	— @ — —
Bar	6 50 @ — —
Sheet	7 50 @ — —
Pipe	— — @ — —
Domestic	4 63 @ — —

TIN PLATES.—Duty, $1\frac{7}{10}$ cents ₱ ℔.

I. C. charcoal, 10x14, ₱ box	6 50 @ 6 75
I. C. coke, 10x14	5 75 @ 6 25
I. X. charcoal, 10x14	8 25 @ 8 50
I. C. charcoal, 14x20	6 50 @ 6 75
I. X. charcoal, 14x20	8 25 @ 8 50
I. C. coke, 14x20	5 75 @ 6 25
I. C. coke, terne, 14x20	5 25 @ 5 37
I. C. charcoal, terne, 14x20	5 50 @ 6 00

NAILS—PER KEG.

10d to 60d, common, fence and sheathing	3 30 @ 3 40
8d and 9d, common	3 65 @ — —
6d and 7d, common	3 90 @ — —
4d and 5d, common	4 15 @ — —
3d and 4d, light	4 95 @ — —
3d, fine	5 65 @ — —
2d, fine	5 65 @ — —
Cut spikes, all sizes	3 65 @ — —
Clinch nails, 1½ to 1¾ inch	5 65 @ — —
do. 2 to 2½ inch	5 40 @ — —
do. 2½ to 2¾ inch	5 15 @ — —
do. 3 inch and longer	4 90 @ — —

SOLDERS.

Half and half	16 @ — —
Extra	15 @ — 15¼
No. 1	13½ @ — 13¾

ZINC.—Duty, sheet, ₱ ℔, 2½ cents.

Sheet (cask) ₱ ℔	7½ @ — 7⅝
Sheet (open)	8 @ — 8¼

STONE.—Cargo Rates Delivered in New York.

Amherst Sandstone, No. 1, buff, in rough, ₱ c. f.	1 00@ — —
do do No. 2	— 85@ — 95
Bedford Stone	1 25@ — —
Berlin Freestone, in rough	— 75@ 1 00
Berea Freestone, in rough	— 75@ 1 00
Brown Stone, Portland, Conn	1 00@ 1 35
Bay of Fundy Wood Point Brown Stone	1 00@ — —
do Mary Point Brown Stone	1 00@ — —
do do Olive Stone	1 00@ — —
Brown Stone, Belleville, N. J	1 00@ 1 35
Granite, rough	— 60@ 1 25
Canaan Marble	1 25@ 1 50
Sutherland Falls Marble	1 25@ 1 75
Dorchester, N. B., Stone, rough, ₱ foot	1 00@ — —

PAINTS.

Carmine, American, ₱ ℔	5 00 @ 5 25
Chalk, ₱ 100 ℔s	— 35 @ — —
China Clay, ₱ ton	18 00 @ 20 00
Chrome yellow, dry, ₱ ℔	— 12½ @ — 28
Lead, red American, ₱ ℔	— 6¾ @ — 7
Lead, white American, pure, in oil	— 7½ @ — 8
Lead, white American, pure, dry	— 6¾ @ — 7
Lead, white English, pure, in oil	— 9 @ — 10
Litharge	— 6¾ @ — 7
Ocher, Fr., dry, ₱ 100 ℔s	1 50 @ — —
Ocher, ground, in oil, ₱ ℔	— 6 @ — 15
Ocher, Vermont, ₱ 100 ℔s	— 75 @ 1 00
Orange Mineral, English	— 9 @ — 10
Paris White, American	— 1⅛ @ — 1¾
Paris White, English, prime	— 2 @ — 2¼
Paris Green	— 15 @ — 28
Plumbago paint, patent, ₱ ℔	— — @ — 25
Putty, ₱ ℔	— 2 @ — 2½
Spanish Brown, dry, ₱ ℔	— 1⅛ @ — 1¼
Spanish Brown, ground in oil, ₱ ℔	— 8 @ — 9
Venetian red, ₱ cwt	1 75 @ 2 00
Vermilion, Chinese, ₱ ℔	— 85 @ — 90
Vermilion, Trieste	— 70 @ — 75
Vermilion, quicksilver, bags	— 50 @ — 52½
Vermilion, American, common	— 15 @ — 18
Whiting, ₱ 100 ℔s	— 60 @ — 80
Zinc, white American, dry, No. 1	— 5 @ — 7½
Zinc, white American, No. 1, in oil	— 8 @ — 10
Zinc, white French, dry, (Red Seal,)	— 7 @ — 8
Zinc, white French, in oil	— 10 @ — 10½

VARNISHES—PER GALLON.

American Wearing Body	3 50 @ 4 00
Coach Body	2 35 @ 3 50
" "	1 80 @ 2 00
Furniture	1 25 @ 2 50
Black Asphaltum	1 00 @ 1 50
Brown Japan	1 00 @ 1 20
Liquid Paint Dryer	1 35 @ 1 75
Harness, (black)	3 00 @ 4 50
Shellac, Spirits	3 00 @ 3 50

CEMENT—PER BARREL.

Portland (imported)	2 75 @ 3 50
Portland (American)	2 40 @ 2 65
Portland (Lafarge)	3 40 @ 3 60
Lime of Teil, ₱ ton	15 00 @ 18 00
Roman	2 75 @ 3 40
Keene's & Martin's, coarse	6 00 @ 6 50
" fine	10 50 @ 10 75
Rosendale	1 25 @ — —

HAIR.

Cattle, ₱ bushel of 7 ℔s	— 16 @ — 18
Goat " "	— 25 @ — 28

SLATE.

Purple, roofing slate, ₱ square	$6 00 @ 7 00
Green Slate	6 00 @ 7 00
Red Slate	13 00 @ — —
Black Slate, Pennsylvania, (at Jersey City)	4 75 @ 5 25
Slate tiles, 1¼-inch, rubbed, ₱ square foot	— 20 @ — 25

PLASTER PARIS.

Duty.—20 ₱ cent ad. val. on calcined ; lump free.

Calcined, ordinary city, ₱ bbl	1 60 @ 1 70
Calcined, city casting	1 75 @ 1 85
Calcined, city superfine	2 00 @ 2 25

LIME—PER BARREL.

State, common	1 15 @ 1 20
" finishing	1 35 @ 1 40
Rockland, common cargo rate	1 20 @ — —
" finishing	1 40 @ — —
Ground	1 15 @ — —

Add 25 cents to above figures for yard rates.

MAHOGANY.

St. Domingo, crotches, ordinary to good, ₱ ft	— 15 @ —28
St. Domingo, crotches, fine	— 20 @ —30
St. Domingo, logs, small	— 5 @ —38
St. Domingo, logs, large	— 12 @ —15
Frontera, Mexican, large	— 12 @ —15
Frontera, Mexican, small	— 6 @ — 8
Other Mexican	— 6 @ —12½
Honduras	— 6 @ —12½

ROSEWOOD.

Rio Janeiro, ordinary to good, ₱ ℔	— 2½ @ — 4½
Rio Janeiro, good to fine	— 5 @ — 8
Honduras	— 6 @ — 12½
Satin Wood, ₱ foot	— 15 @ — 75
Tulipwood, ₱ ℔	— 6 @ — 7
Lignumvitæ, large, ₱ ton	30 00 @ 50 00
Lignumvitæ, other sizes	10 00 @ 25 00

CEDAR.

Cuba and Mexican, small, ₱ super. ft	6 @ — 7½
Cuba and Mexican, medium	8 @ — 9½
Cuba and Mexican, large	10 @ —11
Florida, ₱ cubic foot	40 @ —75

RUBBER ROOFING.

Complete materials for new roof, ₱ square	3 50 @ —

DEADENING AND ROOFING MATERIAL.

Mineral wood for Roofs and deadening, ₱ ℔	— 1¼ @ —1½

REVIEW OF THE MARKETS.—In the lumber market there has been a great deal of "boom" in many of the reports current, and to a considerable extent more than the situation has fairly warranted, in view of the admissions that buoyant expressions are based quite as much upon what is expected as upon what is assured. Ordinarily, it would, of course, be against common business principles to plan operations entirely from the latter basis, and to some extent the rule holds good now, but the imprint of caution has become so thoroughly stamped upon that portion of the trade where the actual exhaust of supplies takes place as to lead to the fear that expectations are tending to become over-sanguine. Prices have apparently reached an altitude where they act as a deterrent to the consumption of goods, and while natural necessities must create quite a demand during the next two or three months, it is a question if supplies do not prove more than equal thereto.

In the brick market, in all essential particulars, common hards have remained about the same as at our last writing. Demand has proved good, and not only fully equal to the amount available, but occasionally so much in excess as to lead to the engagement of parcels before arrival, and as a natural sequence, at full rates, the tone showing much general strength. Builders have all been at work pushing matters wherever opportunity has admitted, and but for the interruptions growing out of unfavorable weather, the consumption would no doubt have proved larger still.

In the lime market moderate offerings have been made and the tone of market has been well preserved at former rates. Sellers, however, have not seemed to be inclined to seek any greater advantage, and all calls have not been without hesitation when made upon a basis of old figures.

In the lath market moderate offerings have again been reported, with no abatement in the demand, an increase if anything, and the seller has retained advantage of the situation.

In the hardware market demand has shown rather greater animation, and toward nearly all regular outlets a very fair supply has been moving, with a tendency to increase, if anything. This has furnished a basis for much general firmness, and full former rates have been in all cases current, with a tendency to advance somewhat on standard goods, as the supply has been very small.

In the metal markets American pig has secured moderate sale to the extent of the early and positive wants of consumers, but, beyond this, orders have not appeared to extend. Supplies have been ample, and the offering readily made. Manufactured iron has been selling fairly with some irregularity on values, but structural shapes have been held pretty firmly, as the available supply has been small. Domestic pig lead has met with slow sale and somewhat uncertain market, but with the general tendency in buyers' favor. Sheet zinc has had a fair average call, and has ruled about steady.

In the nail market a dull business has been reported for most outlets, with a somewhat uncertain position for values. The old list rates have been retained in pretty nearly all cases, and, indeed, have formed the only basis for quotations, but actual business is understood to have taken place at lower figures and the situation has been more or less nominal. Supplies have ample for all calls.

In the paint market business has not been very active or full, and at times the market had a pretty dull tone. Holders have naturally made every effort toward retaining a steady position, and in a jobbing way have been fairly successful.

Wages Paid in Different Cities.

Bricklayers—New York, $4 a day; Philadelphia, $3 to $3.50; St. Louis, $4.50; Cincinnati, $4.50; Chicago, 3.50; Boston, $3 to $3.25; Baltimore, $3.50.

Carpenters—New York, $2.75 to $3.25; Philadelphia, $2.75; St. Louis, $3 to $3.50; Baltimore, $2 to $2.50; Boston, $2.50 to $3; Chicago, $2.50; Cincinnati, $2.25 to $2.50.

Laborers—New York, $2 to $2.50; Philadelphia, $1 to $2; St. Louis, $1.75 to $2; Baltimore, $1.25 to $2; Boston, $1.75 to $2; Chicago, $1.75; Cincinnati, $2.

Painters—New York, $2.50 to $3; Baltimore, $2 to $2.50; Boston, $2.25 to $2.50; Chicago, $2.50; Cincinnati, $2 to $2.50; Philadelphia, $2 to $2.25; St. Louis, $2.25 to $2.75.

The Beet Sugar Industry.

[*Concluded from page 40, February Number.*]

Throwing aside our possible personal prejudices in favor of the beet sugar industry, we appeal to the American people for fair judgment on these failures. It is rational to suppose that if these so-called beet-sugar factories, organized, in nine cases out of ten, by those not having the slightest idea of the requirements thereof, and failing in consequence, had been started in Europe by the same persons, and with the same limited capital, they would there have met with the same results. We cannot here in a few lines recall the whys and wherefores, but will only say that all future establishments of this kind started with a capital of less than $200,000, or far from the center of demand, or where water and fuel are not cheap and abundant, or where the technical manager does not understand all its details the workings of the establishment, will inevitably fail. On the other hand, if correct principles be followed, success is almost guaranteed in advance. We have only to cite two recently organized existing factories; one representing Western enterprise and the other Eastern, which are wonderfully deserving for their perseverance, and which are manufacturing excellent sugar. One of these (the Alvarado factory) is dividend paying. Its sugar is a staple article on the San Francisco market, where it successfully competes with that from the Sandwich Islands. The Delaware Beet Sugar Company, near Wilmington, expects to manufacture this year at least 400,000 pounds of sugar. The Alvarado Company has excellent beets; its sugar product for 1881-1882 is yet unknown, but will doubtless greatly exceed that of the past. Now, here we have two sensibly organized factories that meet with success, while the illy-placed, under-capitaled and ignorantly managed establishments have passed out of existence. What would be thought of moving a large Brooklyn sugar refinery two or three hundred miles from where it is now standing? Is it not equally absurd to transport a beet-sugar factory? Yet all these difficulties are not greater than existed in Europe during the early stage of beet sugar making. As far back as 1747, the great Prussian chemist, Margraff, called attention to the sugar existing in the beet, and the possibility and importance of its extraction. In 1830 some few sugar factories were working. In 1846, nearly a century from the date of its discovery, 100 beet sugar factories were started in the face of opposition of all kinds. From that time until 1860 the questions of home taxation, foreign colonial interests, &c., threw great obstacles in the way. In other words, it took over thirty years in France to establish this beet sugar industry on a proper foundation. But to-day what is the result? There are in Germany, Austria, France, Belgium, Holland and Russia no less than 1,500 beet sugar factories, with an annual production of nearly 3,000,000,000 pounds, and there is no possible reason why we should not avail ourselves at once of the results attained by those older countries in a long series of experiments. If we are to consider as impossible the establishment of the sugar beet industries in the United States, we can no longer consider ourselves the leading—or even a leading—country of the civilized world; and with all our advantages of cheap land, favorable climate, ample capital, intelligent labor, and time-saving, labor-saving and money-saving devices—we had better take a back seat in the grand classification of nations.

But this problem will be commercially solved, beyond all question, within the next few years. The advantages to be derived from the manufacture of all the sugar that we consume, are of an importance that can hardly be realized at first thought. It would render our country industrially and politically independent as regards the most important of commodities. It would introduce a new system of farming, much needed in the New England States. It would place milk, butter, cheese, lard, pork and beef upon our market in still greater abundance, to the advantage of our laboring classes and of our export trade. To supply the United States with 2,000,000,000 pounds of sugar would occupy 1,000,000 acres of land per year, and, making allowance for the desirable rotation of crops, it would be indirectly the means of working at least 4,000,000 of acres. The yield of beet roots would be about 20,000,000,000 pounds. Their manufacture into sugar would consume over 4,000,000,000 pounds of coal: we would have 6,000,000,000 pounds of pulp, representing 35,000,000 pounds of meat. Besides the meat, the manure resulting from feeding cattle on the pulp would be 2,800,000,000 pounds. There would be over 1,000,000,000 pounds of molasses, from which could be made over 32,000,000 gallons of alcohol of 96° B. Employment would be given to nearly 300,000 men, women and children. We would thus give a new market for such materials, consumed or resulting, as coal, bone-black, limestone, matches, brushes, leather, plaster, oils, lubricators of various kinds, sulphur, sulphate of iron, salts of ammonia, soda, bisulphite of lime, muriatic acid, wire of all kinds, rivets, bolts, zinc, tin, borax, tar oils for various purposes, &c. Besides, there would be needed millions of pounds of iron for construction and for various machines in and out of the factory, and hundreds of millions of bricks for factory buildings. We would give employment to engineers, chemists and the representatives of many other branches of industry, and largely increase the demand for hundreds of home products. Further, this would gradually increase the yearly freight traffic on railroads, water-ways, etc. The country at large would be benefitted under the circumstances. We do not know but that governmental encouragement would be desirable. We could then have the very best machines and the highest talent in the best possible location, all of which could not so well be realized under existing conditions. Individuals having property to sell offer arguments in favor of beet cultivation in their particular localities. Overlooking the most important of all other facts, that of probable sugar exhaustion, what would be the possible sugar result? While these lands might be desirable for the cultivation of grain, they might be disastrous for that of sugar beets.

In conclusion, we would say that no less than three factories will be started in Canada in the present year. These, however, are not Canadian enterprises, but started by foreign capitalists who have sufficient forethought to realize that there is money in sugar beets on this continent, notwithstanding unthinking American arguments as to former failures, which prove nothing against intelligent beet sugar making.

Are we, people of the United States, to wait for foreign capital to establish among us beet sugar making on an extended scale; or are we to take immediate action, and prove to Europeans that we are capable of taking care of ourselves without their capital by prudently availing ourselves of their past experience, which we have heretofore so frequently overlooked?

We demand, then, that American farmers shall essay the proper cultivation of sugar beets for cattle feeding, and sugar and alcohol making; that American capitalists shall undertake beet sugar and alcohol making under proper auspices, in favorable localities and with sufficient capital; that state and county premiums to be given for the largest and for the richest beet crops, and for the first commercially successful beet sugar factories and beet alcohol distilleries; and that a fostering government give such rebates upon home Northern sugars, and such appropriations for ample researches, experiments, and reports, as shall enable us within ten years to freight our outbound ships with sugar from the North, to sweeten the great eastward-bound grain and flour product of the new Northwest.

Gilding on Glass.—A home occupation which may be advantageously followed on many a long winter evening is the following: Paint, with a very fine camel's hair pencil, nitro-muriate of gold over a design drawn on the glass. Hold this painted glass over a bottle in which hydrogen is being generated. In a short time the design will shine with considerable brilliancy, and will not tarnish upon exposure to the air.

Steamy and Frosted Store Windows.

The *Ironmonger* discusses as follows a subject of interest to all retail salesmen:

What is the cause of steamy windows? The hackneyed answer that the cold outside condenses the moisture of the air is undoubtedly correct, but it does not explain how the moisture gets into the air. And as the air in the shop is warmer than that outside, its power of retaining water in a vaporous condition is very much increased, so that the watery vapor in the air of the shop must greatly exceed that of the external air, or no deposit of moisture would take place. It is certain that the greatest deposit of moisture takes place in warm, well-closed shops, and the idea that the warmth has something to do with the deposit is a very natural one. A walk along the streets on a winter evening shows that the amount of moisture on the windows varies very much in different shops. Some will be almost free from it, others are as opaque as if they were of ground glass. For some time we have been trying to find the reason for this, and although we cannot explain all the anomalies we meet with, yet we think some light can be thrown on the matter. The best lighted and warmest shops seem to suffer most. Now, as warmth ought to decrease the deposit provided the air could take up no more water as it got warmer, we must look for some means by which the proportion of watery vapor in the air is increased with the temperature. This is at once found in the gas, which is almost universally used for lighting and very often for warming. For the amount of light given out gas produces very much more water than either oil or candles. If the ventilation be thorough enough to keep the air of the shop nearly at the same temperature and humidity as that outside, no moisture will be deposited on the window. But if the air is at all confined, as the assistants will certainly wish it to be, then as long as gas is burned and the products of combustion allowed to escape into the air, so long will the windows be obscured by moisture. As gas is the great offender, it is useless to provide air-tight windows, at enormous cost, if they be lighted with gas inside. We know a shop where some hundreds of pounds were spent in air-tight cases for the windows, where this mistake was made. Another source of moisture is the breath of the assistants and customers, and this seems to be sufficient to make it impossible to avoid all deposit on the windows. But if petroleum or electricity be used to light the shop, or if the products of the combustion of the gas be carefully removed, then the nuisance will be greatly mitigated. Some shops are lighted by "Sun" burners on the ceiling. The effect, as regards illumination, is excellent, and this plan makes it very easy to remove the products of combustion. Of course, if a gas stove be used to warm the place, and the products of combustion allowed to escape into the shop, neither petroleum nor electricity will prevent steamy windows. Various contrivances—such as open gratings at the top of the windows, double sashes, &c., have been tried, but the measure of success achieved appears to have been irregular and often disappointing.

Paper Making in the United States.—The extent of paper making on this side of the Atlantic seems satisfactory. According to recent statistics the number of paper-mills in the United States is set down at 960; in the United Kingdom, 650; in Germany, 543; in France, 539; in Italy, 206; in Austria, 160; in Russia, 160; in Spain, 63; in Portugal, 16; in Belgium, 29; in Holland, 16; in Denmark, 19; in Switzerland, 15; in Japan, 6; in Greece, 1; in Roumania, 1; in Cuba, 1.

Vision.

From the admirable article on "The Eye and its Imperfections," prepared by Mr. Samuel L. Fox, a member of the well-known firm of James W. Queen & Co., of Philadelphia, and issued by this firm in the form of a manual of instruction, we reproduce the following:

As the eye was the first optical instrument constructed, and as by it all other optical instruments are appreciated by man, it is very appropriate, at the beginning of this subject, to describe the structure of that organ of the human body, and show how we are able to appreciate external objects. The globe of the eye or eye-ball is nearly spherical in form and about one inch in diameter. It is a very complex structure, being made up of a series of coats, humors, and muscles, each of which exercises its peculiar function whilst we are enjoying the sense of sight, either of objects at a distance from us or near at hand. Fig. 1 represents an enlarged section of the human eye cut through from the center of the cornea to the optic nerve. S, the sclerotic coating is the external coat of the eyeball; it is white in appearance and extremely hard and tough, giving shape, support and protection to the delicate structures contained within it. A, the cornea, or transparent front portion of the eye-ball. It is more convex in form than the other portions of the ball. The rays of light from objects looked at fall first on the cornea, and at its surface are strongly bent inwards from their original course. B, aqueous fluid, through which the light passes after leaving the cornea. *b b*, iris or colored portion of the eye is a delicate, circular curtain, covering a greater portion of the lens, having an opening in the center, which enlarges or contracts according to the amount of light reaching the retina. P, the pupil or circular opening in the iris, through which the light passes to the lens; by the contraction and expansion of the iris, the pupil is made larger when the light is dull, or smaller under the effects of a bright light. This action is involuntary to us, and is going on from one change to another, upon the slightest variation in the direction of the eyes or amount of light seeking entrance through the lens. C, crystalline lens is a highly transparent, double-convex body, about one-third of an inch diameter and one-sixth of an inch thick, more curved in the back part than in front. The light, on entering the pupil, falls upon this lens, and in passing through it is bent from the course given it by the cornea, and passed towards a point on the retina, at the back part of the eye. K, ciliary processes, or ciliary body, surround, but do not touch, the lens. They are about seventy in number, and pear-shaped in form, being attached at their smaller ends to the choroid coat, and, like it, jet black in color. Their function appears to be, in connection with the ciliary muscle, to adjust the eye for seeing objects clearly that are at different distances from it. H, ciliary muscle, a circle of muscular fiber outside the ciliary processes near the outer edge of the iris. By the contraction of this muscle, the crystalline lens is made to assume a more convex form whenever the eyes are directed to objects close at hand—say from ten inches to five feet distant. D, vitreous chamber, which is filled with a transparent, jelly-like substance called the vitreous humor. The function of this semi-fluid is to transmit to the retina the rays of light which have passed through the lens, and also to give form and strength to the eye-ball. F, the retina or nerve tissue, covering the whole of the back part of the inside of the eye-ball up to the ciliary muscle. On the retina pictures of the objects looked at are formed by the combined action of the cornea, aqueous humor, crystalline lens, and vitreous humor. E, optic nerve, coming from the brain, enters the back part of the eyeball a little toward the nose from the center. The optic nerve, after entering the ball, spreads out over the whole of the vitreous chamber, and forms the retina. Through it the impressions made upon the retina are conveyed to the brain. G, choroid coat, a dark-colored membrane covering the whole of the vitreous chamber outside of the retina. Its inner or pigment layer seems to be intended for the purpose of absorbing the superfluous rays of light which are not focussed on the retina; in other words for a background to the retina. R, macula lutea, or yellow spot of the retina, is a very small indentation on the retina, nearly in a line with the center of the lens and cornea. It is about one-tenth of an inch outwardly from the optic nerve, and is the most sensitive part of the retina. Clear, sharp vision of an object can only be had by turning the eye so that the picture of the object can be formed on this yellow spot of the retina. The eye takes cognizance of an object that is very much to one side, or above or below its axis; but no distinct vision of the object can be obtained except by turning the eyes directly toward it, so that the picture of it will be formed on the macula lutea. On the outside of the eyeball of each eye there are several muscles, by which it is moved inwardly and outwardly, or up and down, as the position of the object that is to be distinctly seen may require.

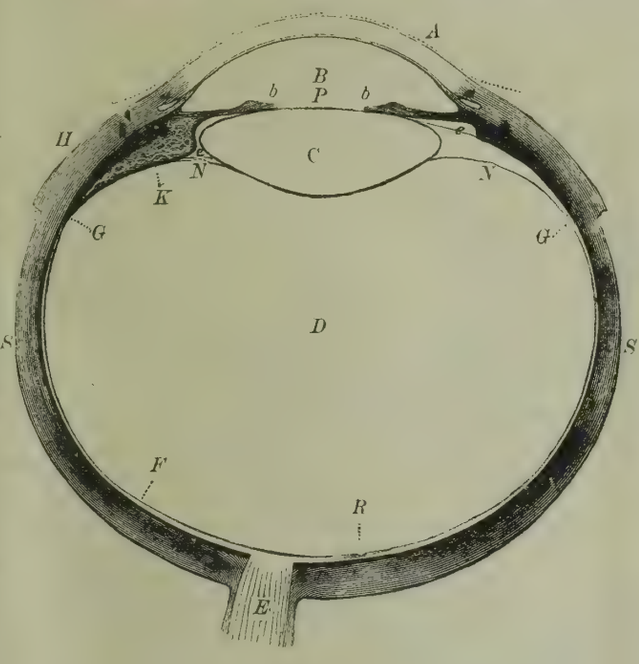


Fig. 1.

Perfect Eyesight.—Our two eyes are absolutely necessary for a right comprehension by sight of size, form and distance. No correct conception of these can be obtained by one eye.

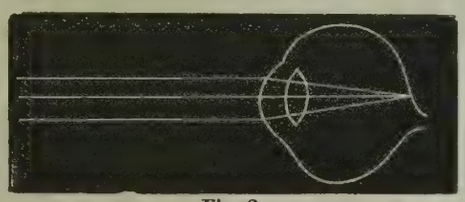


Fig. 2.

A double convex lens covering a hole in the shutter of a darkened room will cause a picture of objects outside the shutter to be distinctly formed on a screen placed at the focal distance of the lens within the darkened room, provided the outside objects are twenty or more feet distant from the lens. The rays of light coming from the objects which form the pictures may be considered parallel rays. If the objects are brought closer to the lens on the outside of the window, the screen in the darkened room must be removed farther from the lens before a clear picture will be formed. The rays which pass from any point of an object so located, and fall on the lens in the shutter, are called divergent rays. All objects nearer to the eye than twenty feet give off divergent rays of light.

In the human eye the chamber behind the iris is a dark room—the cornea, aqueous humor, crystalline lens, and vitreous humor together act as a double convex lens, and the retina is the screen on which the pictures of external objects are formed.

The optical, or seeing, and the muscular arrangements of the different parts of a perfect eye are such that, when the attention is directed to an object twenty or more feet distant from the observer, a perfect picture of such object is formed on the retina, and distinct vision is the result (see Fig. 2). Then all muscles of the eye are at perfect rest, and while so, an object, such as printing, could not be distinguished if held at twelve or fifteen inches from the eye.

The function of the eye termed by oculists "accommodation," is exercised instantly upon the attention being directed to small objects near at hand. It is simply the contracting of the ciliary muscle which surrounds the circumference of the lens. The effect of this contraction is to cause the lens to assume a more convex form, and consequently the combined action of the cornea, aqueous humor, crystalline lens and vitreous humor, is increased in power, and these divergent rays of light are made to form a distinct picture on the retina. The external muscles of the eyes turn the balls inward toward the nose instantly for near vision; then the retina in each eye receives at the same moment of time a similar impression of the object, and thus the convergent muscles, and the muscles of accommodation, act simultaneously for clear vision of near objects.

[*To be Continued.*]

How to Make Brick Walls Water-Tight.

The Sylvester process was successfully applied to the interior walls of the gate houses of the Croton reservoir in the Central park, in New York city, in 1863, on the advice of the late William Dearborn, C. E., and under the immediate supervision of George S. Greene, Jr., C. E., now Engineer-in-Chief of the department of docks.

The process and its results in this case were described fully by Mr. Dearborn in a paper read by him before the American Society of Civil Engineers, May 4, 1870.

The process consists in using two washes or solutions. The first composed of three-quarters of a pound of castile soap dissolved in one gallon of water, laid on at boiling heat with a flat brush. When this has dried, twenty-four hours later apply in like manner the second wash of half a pound of alum dissolved in four gallons of water. The temperature of this when applied should be 60° to 70° Fah. After twenty-four hours apply another soap wash, and so on alternately until four coats of each have been put on. Experiments showed that this was sufficient to make the wall water-tight under forty feet head of water.

At the time of application the walls had been saturated and the weather was cold. The gate chambers were covered over and heated thoroughly with large stoves. The drying, cleaning the walls with wire brushes and applying the mixture took ninety-six days. Twenty-seven tons of coal were used for the drying and one ton for heating the soap solution. Eighteen thousand eight hundred and thirty square feet of wall were washed with four coats. The drying and cleaning of the walls cost 6½ cents per square

foot, and the plant, materials and labor of applying the wash cost 3⅛ cents per square foot.

Recent Developments in Decoration.

Contrary to the prediction of many sober-minded citizens, the "decorative art craze," as they were pleased to call it, has not died out though it has passed through many phases in a few years, and may now be seriously considered as a revival, and as an organized attempt to extend and develop the achievements of art till beautiful things, and the beauty that is the result of harmony in our surroundings, become the rule and not the exception.

The process of distillation that has been going on ever since the Universal Expositions and the importations of Oriental goods began to make the artist's pot boil seems likely to result in such assimilation and adaptation of foreign ideas as to warrant the expectation of some distinctly national achievement. There are few stronger indications of the popular progress of any science or calling than the estimation in which its professors are generally held, and an American must be very young who cannot remember the almost universal indifference to hideous interiors as coeval with the prevalent belief that an artist is a poor devil whose precarious existence is the natural outcome of irregular habits encouraged by fanatical and fantastic ideas.

It is only a few years since the name of an American artist has become commercially valuable. Your paper hanger or carpet dealer no longer urges that this is the most fashionable pattern, but expects your bewildered mind to find relief from responsibility in the name of Tiffany or of Colman.

The commercial element that is so often complained of by modern artists has proved a powerful assistant in the development of art industries. The investors of capital find small returns in dilettant experiments, and the competition of traders has created a demand for the best talent and the most thorough experts. It is becoming generally understood that, to achieve satisfactory results, trained specialists must co-operate, and in methods at least we are approaching more nearly the conditions of the best periods of art.

Much effort is necessarily as yet misdirected; the relative importance of the various branches of art is not yet properly determined; but as we become less fervently enthusiastic, and learn to consider fine art less as a new and delightful pastime, and more as a natural constituent part of material and intellectual life, we shall do things more soberly and advisedly. We shall it is to be hoped, outgrow the present haste to enjoy that which demands the conception and execution of an ambitious scheme in a twelvemonth, at the sacrifice of excellence, and therefore to the exclusion of progressive development. It is in this respect that the commercial spirit is often at fault; it recognizes the necessity of catering to the prevalent taste, but does not foresee that only real excellence can long command popular approval.

What can properly be called the "decorative art craze" is dying out. The absurdity of making our parlors museums of heterogeneous knickknacks, including the æsthetic bulrush standing in a besmeared drain-pipe, is becoming more and more apparent. We are beginning to appreciate that our Japanese collection never appears to such advantage as when collected, that our buhl table is no assistance to our Smyrna rug, and that, in short, style is—style.

The impossibility of reviving conditions that form and develop distinct style—that is, the impossibility of shutting out all foreign influence—makes assimilation and adaptation inevitable; but these terms are synonyms for originality, which in America is not hampered by local tradition, and for this reason should be more strongly asserted here than in older countries.

What has already been accomplished is of course only an indication of what may be achieved when the public becomes more discriminating as the artists become better trained. The conditions of our daily life must in time establish limitations that will be tacitly admitted, determining a kind of natural selection of the fittest of the incrustations of all ages.

Inflammability of Oily Cotton Waste.—M. Renquard, of Rouen, France, has recently made some experiments to determine the inflammability of cotton-waste saturated with various oils. With boiled linseed oil the waste ignited within one hour and a quarter; with raw linseed oil, within five or six hours; with rapeseed oil, after ten hours; whale oil, four hours; fish oil, two hours; castor oil required more than twenty-four hours, and spermaceti oil did not ignite at all.

Miscellaneous and Advertising.

The George Place Machinery Agency, of 121 Chambers street, this city, have always on hand a large line of new and second-hand machinery of every description.

"How to Keep Boilers Clean," and other valuable information for steam users and engineers. Book of 64 pages. Published by James F. Hotchkiss, 84 John street, New York. Mailed free to any address.

The firm of W. F. & John Barnes of Rockford, Ill., was established 1871. They manufacture every kind of foot and steam-power machinery for wood and iron work, employing 65 men, with a pay-roll of about $35,000 per year. They use during that period 75 tons of coal and 300 tons of cast iron.

The Cope & Maxwell Manufacturing Co., of Hamilton, Ohio, make all kinds of pumping machinery adapted to general and special purposes. Their manufactures embrace fire and water works pumps, brewers' and distillers' pumps, vertical and horizontal pumps, and boiler-feed pumps.

With the progress of the industries of this country and the development of artistic taste among our people, the manufacture of clocks has taken a preeminent position. One of the largest concerns in this business is the Seth Thomas Clock Co., of this city, who produce clocks of every conceivable size and description, from the plainest to the most elaborate styles. One of their specialties are tower clocks, and other large clocks for public buildings.

The Tanite Company, of Stroudsburg, Pa., have just issued a handsome 80-page catalogue, embracing full descriptions of their manufactures, all finely illustrated. The Tanite Co. was organized in 1868, and is among the few old manufacturers in its specialties. It carries a stock of goods in almost every large city in the United States, and several in the Old World, and aims to have them considered standard goods by all dealers in the country.

Design for a Suburban Residence.

Our architectural illustrations this month represent elevation and plans for a suburban dwelling, from designs of J. A. Wood, architect, of 240 Broadway, New York. The house is of brick, and the base, sills, lintels and belt courses of stone. The roofs of piazzas and bay windows are of tin; main roof of ornamental slate.

We give the two principal floor plans only. The arrangement of the principal staircase at the back end of the hall, and the recess from which the parlor and dining-room are entered, give greater breadth and space in the front hall, where space is most needed and very seldom had. The door to the drawing-room being opposite the recess doors, gives the interior an air of liberality and spaciousness. The library, or study, is arranged next to the drawing-room, to better accommodate the wants of the occupant. The house was originally designed for a parsonage.

The kitchen is separated from the dining-room by a pantry, to better avoid smells from cooking entering the main house, while they are further kept out of the halls by having the entrance from a rear hall, which is connected by a door to the front hall. In this rear hall is an outside door to the servant's piazza, the stairs to the cellar and second story, and a wash-hand basin, a convenience that will save much climbing of stairs. The coal closet is under the front staircase.

The second story is arranged with the main and the servants' halls connected by a door. The rooms are spacious and well lighted, with an abundance of presses, always desirable to women. The bath, etc., are located in the rear building, from which in no case can smells enter the main house, being shut off by three doors from any room, and, being located so close to the kitchen chimney that the pipes are easily and thoroughly ventilated into it; while the hot and cold water pipes are necessarily short, saving not only expense, but less liability to accident and freezing.

On examining the plans, it will be seen that attention has been paid to making places for furniture in the sleeping-rooms, as well as in the parlors, dining-room, etc., which, when in place, will give greater uniformity to the rooms—the reverse being the common result.

In the attic there can be finished a hall and four very comfortable rooms, with presses, etc., while there can be a neat staircase to the top of the tower if there is a view worth having.

The rear of the cellar should be finished as a basement, with large windows, areas, etc., for a laundry, with stationary tubs, a servants' water-closet, ironing stove, etc., the hot-air furnace, coal-rooms, store-rooms and cellars. The cellar windows are not all shown on the elevation.

The wide piazza over the front door, with a broken pediment flanked with double columns on either side; the extension of the front gable, supported on columns, which in turn rest on the square bay-window, and forming a spacious balcony at the second floor, are not only novelties in design, but exceedingly useful as well as ornamental, showing liberality of purpose in an owner which are not expressed by six-foot piazzas, narrow gables and plain walls pierced only where necessary to let in a minimum of daylight, which too frequently is obstructed, or numerous cumbersome bars, suggestive more of a prison than of a home in its proper sense.

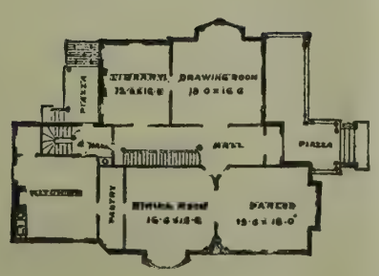
The design is made up of harmonious details, selected for their appropriateness, and does not depend on columns set bottom upwards, windows and doors that have been bought at a second-hand lumber yard promiscuously, and brick walls that look as if the workmen were all apprentices, and each trying, in the master's absence, how many ways he could lay them up without their falling.

The first consideration in making the design was convenience; the second, cost, which would be about $6,000.

Mr. Wood is now engaged on some of the handsomest country residences on Long Island and along the Hudson river. He has promised us a church design for an early number. As he has built upwards of sixty, most of them in competition, we can promise our readers something of more than ordinary merit.

The Builders' and Manufacturers' Mutual Benefit Association is the title of a recently organized institution incorporated under the laws of the State of New York. It is organized on the general plan of what are commonly known as "Co-operative Insurance Companies," with certain specially advantageous features, that recommend it favorably to public consideration. Mr. A. J. Bicknell, late of the firm of Bicknell & Comstock, architectural publishers of this city, is the secretary of the new organization. To those who feel an interest in this subject, we may state that a copy of the prospectus, plans and objects, and constitution and by-laws of this organization, may be obtained by addressing the gentleman above named, at 194 Broadway, New York.

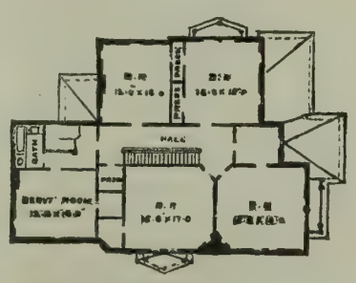
FRONT ELEVATION.



First-Floor Plan.

DESIGN FOR SUBURBAN RESIDENCE,

Costing $6,000.



Second-Floor Plan.

Removing Paint.

A preparation, of which potash and soda are the principal components, has just been introduced into England, and is said to be a perfect paint remover. Some experiments made with the preparation upon various specimens of wood and metal, all old samples, well painted with several coats of good oil colors were very successful. The compound, which is of a cream-like consistency, and quite white, is spread over the painted surface, and after being left on a few minutes is wiped off. Its action upon the body of the paint is thorough and complete, a saponification is set up which continues, the soda is liberated, and this process goes on, the alkali being liberated as it is wanted, till the whole of the paint is removed. Painted surfaces in about a quarter of an hour show every trace of paint cleanly removed, and the wood exposed as if it had been planed.

The action of this preparation seems to be two-fold. There is, first, the destructive action of the applied alkali, always caustic, and, next, a continued sponge-like action going on ; in other words, a constant and perfect causticity is maintained. The result of the preparation on metal is equally convincing. A gas meter, if exposed to the compound about 20 minutes, has the japan removed and the bright metal exposed. Other forms of the preparation are of a weaker character, and nearer soap in their composition. They are intended to remove dirt, and their action is just the reverse of the compound already described. The preparations are liquid and are soluble in water, and their cleansing power upon cloth of an unmistakable dirty and greasy character is said to be almost magical. These solutions are adapted for delicate carvings and fabrics of all kinds and their use by restorers, decorators and others will be highly esteemed. The modification of the solution for cleaning cloth is well adapted for restoring the linings of railway carriages and stuff seats of all descriptions. No scraping or erasing is necessary, and there is nothing injurious, it is said, in the preparations which can attack or injure metals or cloths. They all produce a minimum action on brushes, which is a consideration, and, what is very important, the color is not taken out by the use of the solutions. The price is less than that of other preparations. The "paint remover" can be easily applied by being spread over the painted surface to be removed. It is sold in five-pound tins at about sixty cents.

Diamond Cutters in New York.

Five years ago two diamond cutters dressed and polished all the stones that came in the rough to this market. In the main only the finished diamonds were imported. But it was found that the work of cutting and polishing diamonds was often done carelessly in Europe, and that American workmen could better satisfy the critical taste of American buyers of precious stones. So marked was the difference between the imported diamonds and those cut and polished here that a demand for the stones of American finish was created, and within five years five or six more diamond cutters have established themselves in New York. They dress and polish perhaps one-twentieth of all the diamonds sold in this city and the excellence of their work is recognized.

The stones are imported, and as a rule from South Africa, and although many of the African diamonds are off color, it is said that as large and as fine stones are found there as in the old mines of the East Indies and Brazil. The stones come here in the rough, uneven in shape, and lacking wholly the luster and the sparkle which attach to the very idea of a diamond. The first process is what is called cleaving. By this process the irregularities of shape are chipped off and the general form of the diamond is secured, but without any of the angles which separate the faces. The pieces chipped off, if of suitable color and without flaws, are used for making what are called rose diamonds. Then the faces of the diamonds are cut by the rubbing together of two of the stones, and after this process the stones look like irregular pebbles of ground glass. They are entirely without luster or beauty. The polishing concludes the process. Each face of the diamond is in turn exposed to the surface of an iron wheel revolving 2,000 times a minute, and, by means of oil and diamond dust, the stone is polished and given its wonderful brilliancy.

Henry Fera, a prominent diamond cutter in John street, says that a large part of the work of the diamond finishers in this city is repolishing the stones cut in Europe, to satisfy the more particular judgment of American buyers. On account of this extra pains which is taken with the work here, the diamonds of American polish command somewhat higher prices. An idea of the business in cutting diamonds in this city may be had from the statement that last year nearly 5,000 carats in the rough were cut and polished here. Wages for labor here are from two to three times what is paid in Europe for the same kind of work. The labor adds $10 a carat to the value of the uncut diamond. The loss in weight from cutting is over one-half. This so adds to the value of the diamond that a stone of one carat, costing in the rough for instance, $40, would sell for about $110 when cut and polished. The value however, does not depend alone upon the weight of the stone, but is affected also by the presence of blemishes or impurity of color.

New Publications.

Reports of the United States Commissioners to the Paris Universal Exposition, 1878. Published under the Direction of the Secretary of State, by Authority of Congress. In five volumes. Washington: Government Print. 1880. From Hon. Chas. O'Neill, H. R.

The long-looked-for reports of the United States Commissioners to the last Paris Exposition have at length appeared. They form five moderately bulky volumes, with paper, illustrations and binding considerably better than those of the well-known Vienna and Paris reports from the same department that have preceded them. The value of reports of this nature is chiefly for reference as a record of progress in science and the arts; but they would be of far more direct utility were they published promptly after the close of the exhibition of which they purport to be a history. It is now over three years since the exhibition of 1878 closed, and it has passed out of the recollection of most people. We make this comment by way of protest against the neglect of some of the commissioners to hand in their reports promptly, or the tardy methods of the department, or whatever it may be that causes such unreasonable delay in issuing reports of this kind. On the other side of the Atlantic they do things very differently.

The contents of the five volumes here noticed are as follows: Vol. I. embraces the report of the Commissioner-General, with accompanying papers, including lists of exhibitors and of awards. It is illustrated with a good perspective view and colored plan of the exhibition and grounds, and with a handsome heliotype plate of the medal of the exhibition as a frontispiece.

Vol. II. comprises the reports of the special commissioners in charge of the divisions of the Fine Arts, Education, Wood-Carving and Textile fabrics, and is adorned with a number of fine illustrations.

Vol. III. is of special interest, comprising the reports on Iron and Steel, by Daniel J. Morrell; Ceramics and Glass and Glassware, by Wm. P. Blake; Forestry, by Floyd P. Baker; and Cotton Culture, by P. M. B. Young. Most of the important facts and figures of these reports have already been made public. This volume is likewise finely illustrated with heliotype prints of artistic glassware and pottery.

Vol. IV. is perhaps the most important of the series. It comprises the reports on Chemical Processes, by Thomas E. Jenkins; Mining Industries, Jas. D. Hague; Steam and Gas Engines, A. J. Sweeney; Machines and Machine Tools, Wm. T. Porter; Clocks and Watches, Ed. H. Knight; and Railway Apparatus, Wm. A. Anderson.

Vol. V., the most profusely illustrated of the series, embraces reports on Agricultural Implements and Products, Live Stock, Horticulture, and Pisciculture.

The appearance of the reports is quite attractive, and their general make-up very creditable. We can only repeat our regret, in closing this brief notice, that their publication was so long delayed.

Catalogue of the Pulsometer Steam Pump Co.

The Pulsometer Steam Pump Co., of 83 John street, this city, have recently issued a handsome catalogue showing many illustrations of their celebrated pumps, and containing many useful facts which parties employing pumping machinery should know. The pamphlet contains descriptions of the various styles of pumps made by the company, and many first-class references from parties who have used them, comprising some of the best known firms and companies in the country.

The pulsometer, when first brought before the public some years ago, attracted much attention because of the decided novelty of its form and construction and the extreme simplicity of its operation. Since then it has been materially improved by its makers in the direction of increasing its efficiency and adding to its convenience. The improvements that have been made in the apparatus, while in no wise detracting from the simplicity which characterized the earlier forms of the pulsometer, render it more certain and effective in action, and by making the interior readily accessible for inspection and repairs, as the one or the other may be needed, materially add to the utility of the pump. Every part that sustains any wear is now so constructed that it can be easily removed when worn and replaced at trifling cost. The apparatus, when once set in action, is entirely automatic, and so when once supplied with steam and water, will run day and night without attendance, as the construction is such as to render derangement most difficult; and it requires no oiling or packing. In short, by reason of the extreme simplicity of its construction and operation, its compact form, high efficiency, economy, durability and adaptability to a great variety of service, the pulsometer has very decided points of merit as compared with other forms of pumping machinery. Those contemplating buying pumping machinery will do well to send for the catalogue of this company.

Transactions of the American Institute of Mining Engineers. Vol. IX. May, 1880 to February, 1881. Easton, Pa.: Published by the Institute, at the office of the Secretary. 1881.

The ninth issue of the transactions of the American Institute of Mining Engineers forms a bulky volume of nearly 800 pages, abundantly interspersed with engravings and plates. It contains the proceedings and papers of the Lake Superior meeting, held in the summer of 1880, and of the annual meeting held in Philadelphia, February, 1881. Though all the papers have more or less professional interest and scientific importance, the subject which lends a special value to the present volume is the paper of Dr. Charles P. Dudley, of the Pennsylvania Railroad Co., on "The Wearing Capacity of Steel Rails in Relation to their Chemical Composition," and the extended discussion of the same, participated in by Messrs. Ashbel Welch, Wm. Sellers, Wm. Metcalf, R. H. Sayre, Prof. Egleston, and others. Together they comprise a most thorough and scientific investigation of a subject of the first importance to railroad companies and rail makers. They form a contribution to scientific literature that will have lasting value.

IN PRESS.

Modern House Painting. Containing Twenty Colored Lithographic Plates, Exhibiting the Use of Color in Exterior and Interior House Painting, and Embracing Examples of Simple and Elaborate Work in Plain, Graded and Parti-Colors. Also the Treatment of Old Styles of Houses, together with full descriptive Letter-Press, covering the Preparation, Use and Application of Colors, with special Directions Applicable to each Example. The whole work offering valuable hints and suggestions on Harmonious Color Treatment, suitable to every variety of building. By E. K. Rossiter, Arch. B., and F. A. Wright, Arch. B., late Instructor in Architecture, Cornell University. 1882. New York: Wm. T. Comstock, Architectural Publisher, 6 Astor Place.

Interiors and Interior Details. Fifty-two Large Quarto Plates, comprising a large number of original Designs of Halls, Staircases, Parlors, Libraries, Dining-Rooms, etc., together with special Designs for Low-Cost, Medium and Elaborate Wood Mantels, Sideboards, Furniture, Wood Ceilings, Door and Window Trims, Wainscots, Bank, Office and Store Fittings, in Perspective, Elevation and Detail, making a valuable series of suggestions for Architects and Architectural Designers; and a large collection of Interior Details suited to the requirements of Carpenters, Builders and Mechanics. Reproduced from drawings of prominent Architects of New York, Boston, Chicago and other cities. With an Introduction, Description of Plates, and Notes on Wood Finish. By Wm. B. Tuthill, A.M., Architect, author of "Practical Lessons in Architectural Drawing." 1882. New York: Wm. T. Comstock, Architectural Publisher, 6 Astor Place.

In making notice of the two notable architectural works above named, and which will shortly be issued from the press of Wm. T. Comstock, we can say of them, in advance of publication, from the appearance of the proof-sheets that have been politely sent us for inspection, that their elaborate titles in no wise exaggerate or over-state their merits; and that, taking what we have had the opportunity of seeing as a fair representation of the character of the works, they are worthy of all the praise that can be bestowed on them, both as to the character of the designs and the excellence of their execution. We content ourselves at this time with this preliminary notice, reserving a more extended review until such time as the works shall have been published.

OTHER PUBLICATIONS RECEIVED.

Summary Statement of the Imports and Exports of the United States for the month ended December 31, 1881, and for the twelve months ended the same, compared with the corresponding periods of 1880. Prepared and published by the United States Bureau of Statistics. [Corrected to February 3, 1882].

Analytical and Topical Index to the Reports of the Chief

of Engineers and the Officers of the Corps of Engineers, U. S. Army, upon Works and Surveys for River and Harbor Improvement, 1866 to 1879. Compiled under the direction of Maj. Henry M. Robert, Corps of Engineers, by Louis J. Schermerhorn, C.E., Samuel O. L. Patten, A.M., M.D., and others. Washington: Government Print. 1881. From the Chief of Engineers.

NOTES & QUERIES.

This department is intended to furnish, for the benefit of all our readers, information on any subject of a scientific or technical character falling within the field of THE MANUFACTURER AND BUILDER. *Any of our readers possessing additional or more correct information than that which we give relating to the questions, are cordially invited to communicate it to us for publication. We also request that all questions or answers be written on separate pieces of paper, and addressed to the Editor.*

QUESTIONS.

(2958) SAW MAKING.—You will confer a great favor upon a regular reader by answering the following question: What are the processes gone through with in the manufacture of saws?—F. U. H., Kingston, Mass.

(2959) THE BLOCK SIGNAL SYSTEM.—I have seen the statement in the papers, in speaking of the Spuyten Duyvil accident on the New York Central & Hudson River Railroad, that the block signal system in use by the Pennsylvania road, renders such accidents impossible. Can you tell me where I can find an account of this system? or can you give it in your answers to queries?—H. G., Yonkers, N. Y.

(2960) WATER-BATH WITH CONSTANT LEVEL.—Can you give me in your valuable journal, a plan for a water-bath for the laboratory, that will replenish itself automatically as rapidly as the water evaporates—that is, a water-bath that will constantly maintain a certain level? The constant watching that the common water-bath requires, is one of the standing annoyances of the laboratory in analytical work, and much time and valuable labor is lost by the oversight of the analyst in allowing his water-bath to run dry, whereby the material he wishes to dry at a moderate heat is overheated, and thus decomposed, or scattered about with the expulsion of the last particles of water in the form of steam, and thus the accuracy of the analysis destroyed. The common water-bath requires constant vigilance in its use, and one that would constantly replenish itself and obviato this trouble and the frequent annoyances above named, would be a boon to the analytical chemist. If you can suggest a plan of such an apparatus, or can send me a sketch from which to have one made, you will greatly oblige.—G. D. C., Frankford, Philadelphia.

(2961) PLUMBAGO.—Will you kindly inform a constant reader something about plumbago—what it is used for? what demand there is for it? and what it brings in the market?—M. B. A., Macon, Ga.

(2962) FIRE-RESISTING QUALITIES OF BUILDING STONES.—Which of the natural building stones do you consider to be the best as regards fire-resisting quality?—A. O., Cleveland, Ohio.

(2963) DRY BURNING COAL.—Large coal deposits are being developed all over our State, and the interest that is taken in the same increases materially. The coal is "dry" burning, though it has a different classification by every one; one party terms the same brown coal, another cannel coal, and so on. You may better judge of its quality by knowing that its gas producing capacity is 14,000 feet of gas to the ton—of course without tar or coke. Would this coal be applicable for heating—rather, firing purposes on railroads? Is such coal used on any railroad in the United States? and with what success, if any? What is the comparative difference in the value in the use of this coal and good wood—that is, which is cheaper? How are fire boxes constructed? Are engines and boilers more affected in wear by the use of coal than wood. Will you have the kindness to answer the above through your journal, as it will interest a good many of your readers here, besides myself, who am a subscriber and devoted reader.—C. H., Austin, Tex.

(2964) TO PRESERVE A CRACKED PICTURE.—I have a painting that is cracking badly; what can I do to prevent it cracking more? I tried raw oil, but it does not seem to soak in enough to soften and prevent it.—K., Wakefield, Mass.

(2965) RENOVATING OLD HATS.—What can I do for a common stiff hat, after it begins to look rusty, to restore its freshness? I understand that when they are made, they are finished with a sizing of shellac; but I can think of nothing that will accomplish the object.—K., Wakefield, Mass.

(2966) FATS AND FATTY ACIDS.—What is the process in detail for extracting grease and fats from water or suds in which wool has been washed? and also the process in detail for extracting from the same the acids, oleic, stearic, etc.? What is the best work on industrial chemistry?—F. H., Yonkers, N. Y.

(2967) CONTINUOUS PROCESS FOR OXYGEN.—Can you refer me to a description of the process of Tessie du Motay for generating oxygen continuously?—H. W., New York City.

(2968) COMMERCIAL PRODUCTION OF HYDROGEN.—Did not the same inventor devise a process for producing hydrogen on a large scale?—W. H., New York City.

(2969) DISTILLATION OF WOOD.—Do you know of the existence of an establishment for the distillation of turpentine, etc., from light wood? There was such an establishment somewhere in New Jersey a few years ago, of which a Mr. A. H. Emery was superintendent, but I have heard nothing of it for some years. If you know of anything of the kind, please inform me.—J. H. H., Mobile, Ala.

(2970) INSTRUCTION IN LITHOGRAPHY.—I want to learn something about common lithography—the manipulation of the varnishes, inks, transfer paper, transferring, etc. Can you furnish me a book on the subject? If so, state title, size and price of book.—J. R. S., Monroe, Me.

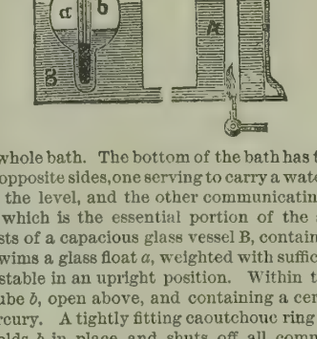
(2971) GRAVEL HOUSES.—I notice that Prof. O. S. Fowler recommends the building of gravel houses as healthy. Is there any work, or practical information to be had, on the subject? If so, please inform me and oblige.—G. W. S., Bellefontaine, O.

REPLIES.

(2958) SAW MAKING.—The following is an outline of the processes used in making saws in the immense establishment of Henry Disston & Sons, Philadelphia, whose saws are known the world over: The steel, which is all "crucible," is made in the works from Swedes iron, brands "hoop L G" and "hoop F." The bars are cut small and mixed with scrap steel from the manufacture of saws and files. Carbon is added in the proportion of 1 ounce to from 4 to 5¼ pounds of iron (say 1⅛ to 1 per cent). The thicker the saws to be made the less carbonized the steel. The metal is melted in graphite pots, holding from 65 to 85 pounds each, and run in iron molds into ingots varying in weight, dimensions and shapes, according to the style and size of saws to be made. Thus, an ingot for 1½ dozen hand-saws, 26 inches long, and tapering from 7⅞ to 3 inches, weighs 48 pounds, and is a flat block 6⅛×12×2 inches in size. A 6-foot of 14-plate requires an 11-pound ingot. Peculiar tongs are required to grip the sheets, and great skill is necessary to prevent their slipping. While being rolled to the proper gauge, the plates are slapped vigorously against the hard and level floor to slam off the scale and dirt which would otherwise be rolled into them. After rolling, the plates are cut to outline by powerful shears; then, if large, "gummed," or toothed, by properly shaped dies in fly or cam presses. For small hand-saws, the teeth are nicked out by a rapidly revolving cutter in an automatic machine, cutting out 500 teeth per minute. A Sheffield operator, using a fly press, tooths a hand-saw with 115 teeth in less than two minutes, and his regular task is two dozen 24-inch saws in 8 hours. Circular saws have the eye drilled out before toothing. After toothing comes hardening, the toothed plates being heated to a light cherry-red, and then plunged into a bath composed of whale oil, tallow, rosin and beeswax. The plates, after hardening, are very brittle; they are also covered with dirt, grease and scale, which is removed by scraping and scouring with sawdust. They come out buckled, and require to be flattened. This is done between heated dies, brought together by hydraulic pressure. These dies are circular in form and horizontal in position, and about 5 or 6 feet in diameter. They are enclosed in a furnace with regulated blast, and are revolved, to keep the temperature of all parts uniform. The proper color for hand-saws is a blue, corresponding to a spring temper. After removing from the tempering dies, hand-saws are piled up and held down by a weight of the shape of the blade, to keep them flat and straight. Each hand-saw blade is tested by a straight-edge, and by bending in a circle. If it does not perfectly recover its original position, it is rejected and re-hardened. The teeth of these same spring-tempered blades are then laid on a "stake" and struck smartly with a light hammer, to see if they will take a permanent set; unless they will the saws are not up to standard. After being "smithed," the blades are ground. Wood and hand saws are sprung into the inside of the rim of a large rotating iron wheel (about 10 feet in diameter), and thus presented to the face of a rapidly rotating grindstone. Cross-cuts are ground between two high stones (6 feet diameter, 8 inches face, and weighing about 2,500 pounds each), the distance of which apart is regulated by a screw. The blade is passed back and forth between the stones, working from the back of the saw towards the teeth, the feed being reversed at each pass, and the stones brought nearer together as they wear away. The operation is repeated until the saw is of the required gauge. The stones have a peripheral velocity of about 3,000 feet per minute. Circular saws are ground by passing them through a special machine having two large grindstones, the axles of which may be brought nearer together by a screw. The saw is on a temporary arm on a carriage having a traversing motion, so that all parts of its surfaces, from rim to center are exposed to the action of the stones. Circulars are ground even gauge throughout, or tapered at the rim, or thin at the edge, according to circumstances. They are polished and given the appearance of having been ground circularly by revolving them on a face-plate and pressing against them successively blocks of lead, cork and leather, supplied with emery and oil. No matter how flat a saw may be pressed between the tempering dies, most saw makers claim that the tension will be uneven in spots, and that hammering is required to equalize it. The saw straightener compensates for the expansion due to centrifugal motion, by giving a rim tension, which, while insufficient to dish the saw while at rest, will nevertheless be there when wanted, and will counteract the expansion of the rim at high speeds. These operations of curing defects in the plate are performed only by skilled operators with hammers of special form. The saw is now finished; or if a hand-saw or cross-cut, requires only to be furnished with a handle to be ready for the market.

(2959) THE BLOCK SIGNAL SYSTEM.—The following brief account of the arrangement and operation of the block signal system in use by the Pennsylvania Railroad Company, will answer our inquirer's question: The whole distance is divided into "blocks," each block provided with a signal station Between Philadelphia and Newark there are sixty of these. Between Newark and Jersey City, where trains run with greater frequency, there are ten. They are not, anywhere along the whole road more than four miles apart. Each station is provided with a three-fold signal, with ample telegraphic connections. This signal is erected directly over the track, in full view of the engine driver. He must not pass from one block to the next until this signal tells him that the way is clear. The signal consists of a frame, in the center of which is a circular opening about as big as the head of a barrel. This is so arranged as to display white, red, or green, as may be wanted. Red means that the train must stop, for there is danger of obstruction. White means that the next block is clear, and that the train must go on. Green means that the green flags which adorn the rear end of a train have recently passed on, and that the engine-driver must proceed with caution until he comes to a station which displays a white light. Whether the blocks are short or long, no train is allowed to go on a block until that block is reported by telegraph to be clear. Thus there is no danger that one train will run into the rear of another. But, it may be asked how will it be if the man in the signal station is suddenly struck with paralysis or overcome by slumber? This question is answered by the statement that red is the normal state of the disc which the engine driver sees. Red means "stop." The signal is changed from red to white or green only by the action of the signal man, who, by pulling a rope, brings white or green to view. When he lets go of the rope the signal again displays red, and no train proceeds until there is a change. It does not seem possible to provide anything more simple or more trustworthy than this. Of course, the working of such a system costs something. But it prevents accidents, which are the most costly things in railroad traffic.

(2960) WATER-BATH WITH CONSTANT LEVEL.—Several plans have been proposed for the construction of water-baths that would maintain a constant level automatically, and therefore obviate the necessity of replenishing. We give herewith an illustration of one of the simplest of these, which is in use in some laboratories, and which would be in very general use if its convenience were once known. The cut is a vertical section across the apparatus; A is the water-bath of copper, cylindrical in shape and flared funnel-shape at the top to receive evaporating dishes, etc. It is suspended from a bracket at suitable hight, and is heated beneath by the Bunsen lamp shown in cut, the combustion products passing up through the flue, which is carried through the shell of the bath and terminates beneath a large hood communicating with the chimney, and which is so placed as to



cover the whole bath. The bottom of the bath has two lateral outlets on opposite sides, one serving to carry a water glass for indicating the level, and the other communicating with the regulator, which is the essential portion of the apparatus. This consists of a capacious glass vessel B, containing water, in which swims a glass float *a*, weighted with sufficient water to keep it stable in an upright position. Within the float is placed a tube *b*, open above, and containing a certain quantity of mercury. A tightly fitting caoutchouc ring *e* between the two holds *b* in place and shuts off all communication with *a*; and lastly, within *b* is a smaller glass pipe *c*, connecting with the water service, and its lower end dipping somewhat into the mercury in *b*. The pipe *c* is held immovably by clamps, indicated at *d*, attached to the outer vessel B, and does not partake of the up-and-down movements of the float *a* about to be described. The following is the operation of the apparatus: The bath A and vessel B being in communicating vessels, the water in both stands at the same level. As the heat of the lamp lowers the level of the water in the bath by evaporation, it is at once restored by the influx of

water from B. The loss of water in B, however, causes the float to sink. In so doing, it carries the tube *b* with it, and the opening of the tube *c*, which is held immovable, is thus left under the pressure of a smaller mercury column. When the sinking of the float has reached a certain point, the pressure of the water in the main becomes greater than the resistance of the mercury seal. Water bubbles through the metal, fills the tube *b*, and overflows at *c* into the reservoir B. The level is now restored in the bath A by the flow of enough water through the communicating pipe to equalize the level. The increase of the water in reservoir B causes the float to rise: this in turn buries the orifice of the tube *c* deeper in the mercury, the increased resistance of which prevents further flow from the water main. The original level has been restored by the operation here described, and the equilibrium restored; but only to be destroyed again by the continued vaporization of the water in the bath, which causes the action above named to be indefinitely repeated. The hight at which it is desired to maintain the water in the bath, can be regulated by varying the immersion of tube *b* in the mercury by means of the clamps, or by varying the quantity of mercury in *b*. One of these regulators can be made to do service for quite a number of water-baths, by running a water pipe from the regulator behind them and connecting a branch pipe with each bath. This regulator, as we know from actual experience, works admirably. Materials can be left upon it over night, or for days together, if necessary, without risk of damage from the bath running dry.

(2961) Plumbago.—Plumbago is used for a great variety of purposes. The earliest and still most widely extended use of this substance is for the production of marking crayons, or lead pencils, as they are popularly called. It is used also in large quantities in the manufacture of crucibles or melting pots, used for melting gold, silver, steel, copper, brass, and other metals and alloys. It is also used considerably as a stove polish. It is highly prized as a lubricant for bearings and other moving parts of machinery subject to friction. It is used by electrotypers as a conducting surface for coating the face of their wax molds, preparatory to placing the same in the battery. It is used also to a considerable extent by foundrymen as a facing for their molds, to produce smooth finished castings. Piano and organ builders make use of it to coat the bridge over which the wires are drawn, to prevent the adhesion of the wires to the wood. It is used likewise to some extent by hatters to impart a peculiar tone to the colors and a softness and smoothness to the touch of felt hats; by glass-makers for coloring dark glass for carboys, bottles, etc.; by boat-builders for covering the bottoms of boats and yachts, especially for racing boats; for refractory mixtures, for tuyeres, pointing up furnaces, etc.; for paint for iron and other work exposed to the weather. It is used in powder mills for polishing the grains of gunpowder, and in shot towers for a similar purpose. These are the principal uses of this valuable material, that occur to us; but there are doubtless many more, depending on its refractory properties, its lubricating qualities, its excellence as a conductor of electricity, and its indifference to atmospheric influences. From the foregoing statements, it will be apparent that the demand for plumbago is very large. We have no means of knowing what the total consumption of plumbago is, but the quantity annually imported into the United States exceeds six million pounds, representing a value of about $150,000. The home production in New York, Pennsylvania, Canada and elsewhere, probably equals this amount. The world's yearly consumption will probably not fall far short of 25,000,000 pounds. The market price varies according to quality, from $25 to $75 per ton.

(2962) Fire-Resisting Qualities of Building Stones.—Respecting the fire-resisting qualities of building stones, we may say generally that in this respect the limestones are decidedly the poorest, as they calcine rapidly when exposed to high temperatures. This fact was very noticeable in the great fire in Chicago, where, as in other Western cities, many of the buildings were of this stone. Of the limestones, again, the variety known as the magnesian, or dolomitic limestones, are the poorest, as the presence of magnesia lowers the temperature required to effect the calcination and disintegration of the stone. Granite, gneiss, and other composite crystalline rocks, especially such as contain mica, are not well adapted to withstand fire, as they are liable to crack and fly asunder with explosive violence when exposed to strong firing. This property is ascribable to the fact that water readily finds its way into the mass of the stone by capillarity between the laminæ of the mica, and between the other crystalline fragments of which the rock is composed, and this, when highly heated, expands into steam, cracking and fissuring the stone, and even disrupting large blocks with violence. This fact of the violent disruption of granite blocks was noticed repeatedly during the great fire in Boston, where many of the burned buildings were massive granite stores, and at the destruction by fire of the huge granite structure known as the Jayne Building, in Philadelphia, in mid-winter some years ago. The sandstones are, as a class, the best building stones as respects their fire-resisting qualities. They are generally very close in texture, only slightly absorbent of moisture, and generally composed of fine quartz particles, a substance which is only fusible at enormously high temperatures. None of the natural building stones, however, can approach brick in this quality.

(2963) Dry Burning Coal.—From the general description given by this inquirer, we should be inclined to class his coals with the non-coking, free-burning "block" coal of Indiana, although its gas producing qualities are far above that of the Indiana coal. Unless it should be found to contain considerable sulphur, this coal would, we think, be well adapted for firing steam boilers, and for locomotive use. The block coal of Indiana is used for domestic purposes, and for steam generation and iron smelting with equal satisfaction. The following report was lately made upon it by the Superintendent of the St. Louis, Vandalia & Terra Haute Railroad, after two years' use in their locomotives: "The coal is free-burning, does not cake in the fire-box, makes no clinker, burns completely to ash, and requires very little more attention in firing than wood. Its freedom from sulphur renders it comparatively harmless to the iron of the furnace and flues, and the only difference between it and wood is that the heat is concentrated upon the lower sheets of the fire-box instead of being more generally diffused, as is the case with wood, etc." The same coal has been adopted upon many other roads, and with entire satisfaction. It does not require as much draft as coking coals, consequently an engine may be run with it that is constructed for burning wood. But to obtain the best results, an excess of draft must in all cases be avoided, as this involves waste. Coal of any kind is more destructive than wood upon the fire surfaces of locomotives and other forms of steam generators. It would be impossible to state with positiveness just what would be the comparative cost of wood and coal for steaming purposes, as this would depend on circumstances that vary very much according to locality; usually, however, there is not much difference between the two. We would suggest to this inquirer to send a few average samples of this coal to an expert chemist to have an analysis made, in order to determine its character and its freedom from deleterious ingredients. It might be useful to him also to send a sample to the State Geologist of Indiana, Prof. John Collett, Indianapolis, Ind., with the request that he compare it with the block coal of that State.

(2964) To Preserve a Cracked Picture.—An application which is said to answer the purpose of preserving a scaling or cracked picture very well, is made of a mixture of equal parts of linseed oil and methylated chloroform, which is to be poured over the painting if the colors are too brittle to bear the friction of a soft brush. After remaining on the surface of the painting for a day or two, the excess of oil may be removed by means of a piece of cotton wool, or a soft brush, a fresh portion of the preservative applied, and the excess removed as before. This process must be repeated from time to time until the colors are firmly fixed, when the painting will bear friction, and may be cleaned or varnished. It is recommended, however, to remove as much of the dirt from the picture as possible (if there be any) by careful washing with soft water, previously to making the above application. The mixture will not restore the cracks in a painting, but simply fixes the colors, and by rendering them very elastic, prevents the cracking from progressing further. A mixture of one part of methylated chloroform and two of linseed oil is used for reviving the colors of paintings. After washing, a small portion is rubbed over the picture with cotton wool, and on the following day the painting is wiped over with a soft silk handkerchief. Oil and chloroform, when used in the proportions given, possess the property—so it is claimed—of restoring the faded colors of paintings, and of developing colors, which, by reason of age, have perished to the eye.

(2965) Renovating Old Hats.—Hatters use either a spirit or alkali size for stiffening hat bodies. The former is a thin varnish composed chiefly of shellac, to which a small quantity of gum sandarach, mastic and copal is added, and the whole dissolved in wood spirit or alcohol. The copal is dissolved separately from the others, and is added to the other solution. The alkali size is made by dissolving substantially the same ingredients in a borax solution. It is applied hot. When the application has been made, the hat body is warmed in a drying oven, and then steeped all night in water to which a small quantity of sulphuric acid has been added. This sets the stiffening in the hat body. We incline to the opinion, unless our inquirer thinks of opening a renovating establishment, that he would find it cheaper to buy a new hat than bother about reconstructing an old one.

(2966) Fats and Fatty Acids.—To recover grease and fats from water or suds in which wool has been washed, several processes may be employed. One of the best is to treat the water with sulphuric or muriatic acid, by which the grease or fat is decomposed and the fatty acids separated. This should then be removed to a separate vessel, preferably a lead lined wooden one, heated to 212° with live steam. A small quantity of chalk should be added to neutralize the free sulphuric or muriatic acid present, and the mass thoroughly stirred with the addition of hot water. It should then be left standing for some time to settle, and the fat can then be drawn off clear. It can be reconverted into soap by alkali, or may be further refined by the methods in common use and used for the preparation of candles. The following plan, according to Simmons, for recovering oils and other useful matters from soap suds and other waste waters, in use in England, is to treat them with the exact amount of a mineral acid requisite to liberate the fatty acids in the form of magma (or paste). This is placed in filters and treated with acid and alkali, and pressed with the aid of heat to separate the fatty acids. The fatty acids are distilled in stills lined with a metal or alloy not acted on by oil, a steam jet or exhauster assisting in the discharge of the vapors. There are several excellent works on industrial chemistry. Muspratt's is probably the most extensive. Bolley's "Handbuch der chemischen Technologie" is very thorough, but there is no English translation. "Wagner's Hand-Book" is also very good, and has been translated by Crookes. The best work on the subject, being both exhaustive and modern, is "Spon's Encyclopædia of the Industrial Arts, Manufactures and Commercial Products," published by E. & F. N. Spon, London and New York.

(2967) Continuous Process for Oxygen.—If we do not mistake, the French technologist du Motay took out several American patents on improved methods of making oxygen by continuous processes. By consulting the indices of the American patent office reports, this inquirer should be able to obtain the desired information authoritatively. We have at present available only one reference to du Motay's oxygen process. It is as follows: The principle of the process is based on the fact that the manganates and per-manganates of potassa, soda, baryta, etc., the ferrates and chromates of the same class, and in general all metallic oxides or acids that will form with potassa, soda and baryta, binary compounds capable of superoxidizing, possess the property of yielding up their oxygen at a more or less elevated temperature, when they are subjected to the action of a current of steam. When thus deoxidized, these same bodies possess the property of regeneratfon, by absorption of a quantity of oxygen equal to that which they have lost, when they are exposed at a more or less elevated temperature to the action of a current of air. The atmosphere is, therefore, the constant source from which the oxygen is derived. The mode of operation is thus described: one of the binary compounds just enumerated is placed in a distilling vessel, whether at the maximum or minimum state of oxidation. If the compound is in the latter state, it is superoxidized by means of a current of air mechanically drawn over it; if at the former stage, it is deoxidized by means of a current of steam. The oxygen and the steam, on issuing from the mouth of the retort, pass together into a condensing chamber, in which the steam is retained, while the separated oxygen is passed over into a gas-holder, and is there collected. When the charge is exhausted by the liberation of all its available oxygen, the steaming process is stopped, and the material is again regenerated, or superoxidized, by means of the air current, and so on. So far as we have been able to learn, the process does not work in practice as smoothly as could be desired, from the fact that the regeneration of the charge cannot be indefinitely repeated, and because its powers in this respect rapidly fail.

(2968) Commercial Production of Hydrogen.—Du Motay devised a process of producing hydrogen on a commercial scale, his object being to utilize the gas as an illuminating agent after carburation with light petroleum products, or other enriching material. The process is, in brief, as follows: He forms water gas (hydrogen and carbonic oxide) by passing steam into a furnace charged with coke heated to redness. The novelty of the procedure consists in the method of removing the carbonic oxide of the water gas, which he claims to accomplish by passing the mixed gases through cylinders charged with hydrated lime heated to redness. The result of this treatment is said to be the conversion of the carbonic oxide into carbonic acid, by union with an equivalent of oxygen liberated from the water of hydration, and the formation of an additional equivalent of hydrogen. The carbonic acid remains behind in combination with the lime, as calcium carbonate, while the hydrogen is enriched by leading it through a carburetor charged with gasolene, whence it passes through a set of iron tubes heated to dull redness. This treatment is claimed to convert it into gas of high illuminating quality.

(2969) Distillation of Wood.—The works of which Mr. Emery was superintendent were destroyed by fire about the year 1867, and were never rebuilt. There are a large number of establishments throughout the Eastern States, and some in the West, engaged in the distillation of wood, utilizing the charcoal for smelting and other purposes, and gaining acetic acid, wood spirit (methylic alcohol) and other chemical products therefrom. We need only name one establishment of this kind, namely, Harrison Brothers, of Philadelphia.

(2970) Instruction in Lithography.—Replying to this correspondent, we may inform him that the best work on lithography with which we are acquainted, is "The Grammer of Lithography; a Practical Treatise on Commercial and Artistic Lithography, and Chromo-Lithography, Zincography, Photo-Lithography, and Lithographic Machine Printing." By Richmond. The price is $2.50, on receipt of which we will mail this work, postage paid.

(2971) Gravel Houses.—This inquirer's question is unintelligible. We must ask him to repeat it in more understandable form. Let him give a brief quotation from Prof. Fowler, embracing his recommendations, to make it plainer.

THE MANUFACTURER AND BUILDER,
A PRACTICAL JOURNAL OF INDUSTRIAL PROGRESS.

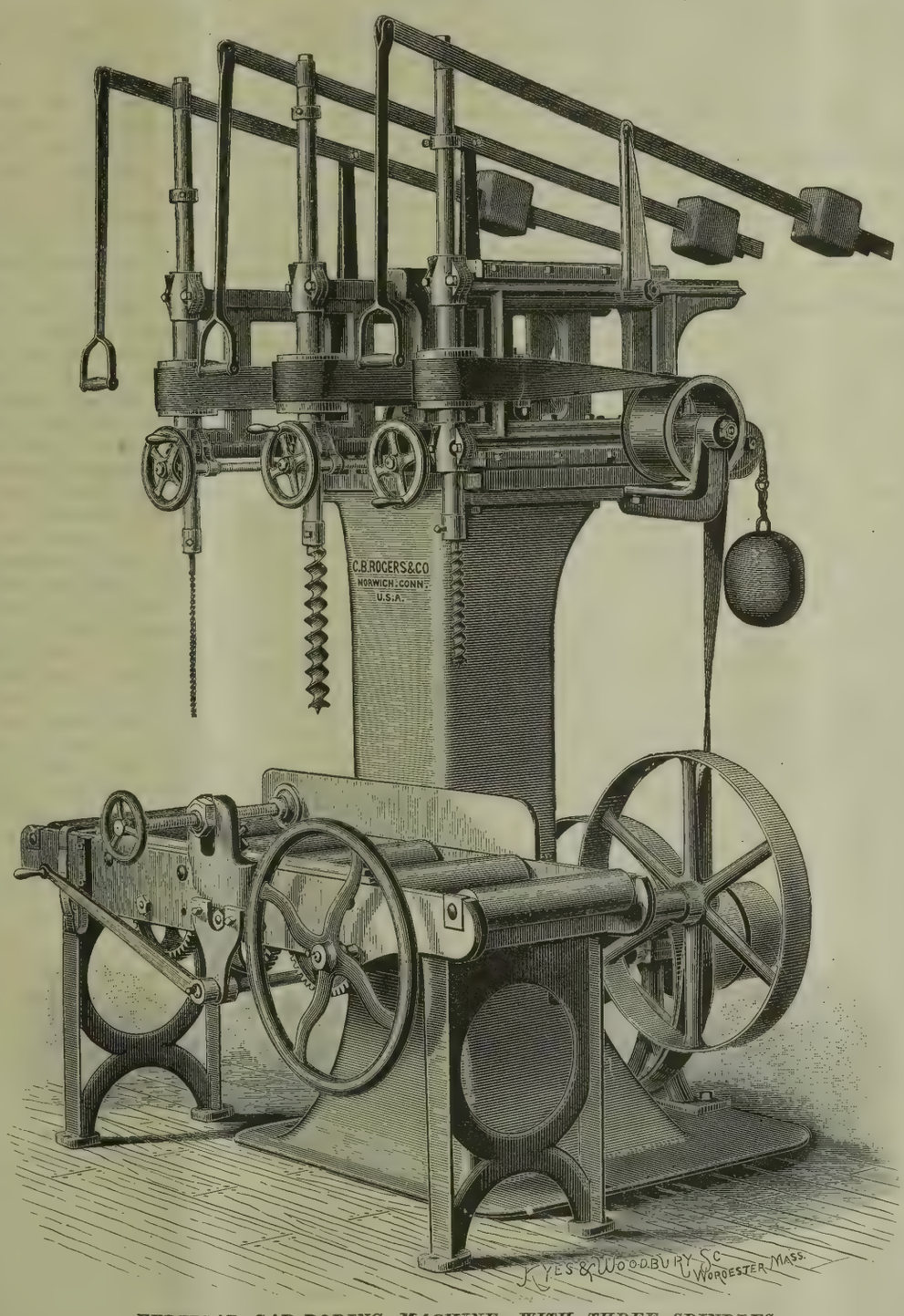
Vol. XIV.—No. 4. APRIL, 1882. Fourteenth Year.

Vertical Car-Boring Machine.

From the numerous products of the extensive wood-working machinery establishment of C. B. Rogers & Co., of Norwich, Conn., we select for description their vertical three-spindle borer, which possesses certain practical features of construction which will interest our mechanical readers.

The machine referred to, and which is represented by the accompanying engraving, has been recently constructed from new patterns, and is designed for boring heavy timber with different sizes of holes without the delay and trouble of adjusting the spindle, or changing the bits, necessary in single-spindle machines. This machine has three spindles, operated by the handles connected with the weighted levers at the top, and driven by one belt from a counter-shaft at the back of the machine. By a heavy weight, in connection with adjusting friction pulleys, the belt remains at the same tension whatever the position of the bits. The middle spindle has a larger pulley than the other two, for slower speed to work the larger bits. Seventeen bits are furnished, varying from ⅜ to 2 inches—all above 1⅜ inches to work in the middle spindle. The bits have a horizontal adjustment of 15 inches, and vertical throw of 16 inches.

The bed upon which the timber rests is furnished with four rollers, which can be operated by the hand-wheel, or by the lever which operates the friction power feed attachment from the counter-shaft. The machine is built wholly of first quality iron and steel, and in the most substantial manner, thus making a useful and durable tool for all kinds of timber boring. The counter is attached to the base of the column, and is furnished with tight and loose pulleys, 10-inch diameter and 5-inch face, which should be speeded to 275 revolutions per minute.



VERTICAL CAR-BORING MACHINE, WITH THREE SPINDLES.

A Camp-Kettle Steam Engine.—A subscriber, E. L. Hulme, says that while in prison during the war, he and another man took two camp kettles and soldered them together and made a steam engine to drive a small drill. With this they drilled holes in gutta-percha and made buttons. When they were discharged from prison they sold their engine for $25 in gold.

The Illinois and Mississippi Canal.

An earnest effort is being made in the interest of cheap transportation to induce Congress to grant an appropriation for the construction of a canal to join the waters of the Mississippi River with those of the Illinois. The proposed section of canal would extend from the Mississippi at Davenport, Iowa, opposite to which is the important government armory and arsenal on Rock Island, forming a union with the Illinois river at Hennepin, the western terminus of the Illinois and Michigan canal. The total length of the proposed canal would be 65 miles, and its estimated cost, according to the surveys and reports of the government engineers, would be $3,899,723.

The friends of this enterprise urge that it is a measure of national importance, that it will unite ten thousand miles of water routes that now float the principal commerce of the continent, as it will form the connecting link which alone is wanting to join the Mississippi with the great connected water routes of the Great Lakes.

The enterprise has many warm friends and advocates, and its favorable consideration will be strongly urged upon the national legislature at the present session.

The following is a specimen of the arguments urged in its favor: "The Hennepin canal, which has taken its new and proper name in Congress of the Illinois and Mississippi canal, is not in any sense a private or local measure, designed to build up any city or interest, but is most truly national in the broadest sense. The government is simply asked to give the Northwest a

water outlet to the East, to cheapen the transportation of that which enters into the welfare of every citizen—food. Though this canal may, in fact, carry but a small amount of the vast productions (1,300,000,000 bushels) of the Northwest, it is confidently expected that it will cheapen the cost of transportation of every pound of produce that finds its way to market; cheapen it in the same manner that the Erie canal cheapens all produce crossing the State of New York; or the Illinois and Michigan canal causes grain to be carried several cents per bushel cheaper from points near its terminus than it is carried by railroads that have no water competition; or the Great Lakes from Chicago to Buffalo cheapen freight on all the East and West routes, (though it carries but 40 per cent of it), by being an always ready means of transportation at certain reduced rates. This route is expected to serve as an irresistible freight regulator, if built by the government, that will preclude the long felt necessity for government legislation to control through business on our East and West railroads, and will effect this desired result in a much less objectionable manner, as there can be no valid question as to its construction being a proper exercise of constitutional right inherent in our government."

The Manufacturer and Builder.

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This journal has the largest circulation of any mechanical monthly published in the United States. Its value as an advertising medium is therefore apparent.

Vol. XIV., No. 4. Fourteenth Year.

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A Special Edition for May, 1882.

We propose, in accordance with our custom at stated intervals, to issue an extra edition of 10,000 copies of the May number of the Manufacturer and Builder, over and above our usual issue. This plan which gives our regular advertising patrons the benefit of an extra circulation, judiciously directed to such lines of manufactures, as in our judgment will be of the most service to them, is worthy of the special attention of those who are classed among our occasional patrons, to whom we take this opportunity of commending it as an unusually good chance, presenting the merits of their specialties to the most desirable manufacturing elements throughout the country. No addition to our usual schedule of prices will be made for advertising in this number, and as these "extra" issues have proved their popularity in the past, we are satisfied that this notification will be all that will be required to insure a large participation in the exceptionally good opportunities for advertising which the special edition of our May number will afford.

Engineering Extraordinary.

In the December number of the Cincinnati *Miller and Millwright* there appears an article copied from the London *Brewers' Journal* (which must not be confounded with our bright Philadelphia contemporary of the same name), which article, for downright ignorance, caps the climax.

How the editor of the *Miller and Millwright* could ever have admitted into its pages an article embodying such glaring mistakes in first principles, passes our comprehension, save on the supposition that he did not know any better himself.

We propose in what follows to boil down the misstatements of the *Brewers' Journal* as copied in the *Miller and Millwright*, to show our readers the kind of "popular" science that is dished up for the brewers of England and for the millers and millwrights of our own great and glorious country. The *Brewers' Journal* says:

"It is well known that water converted into steam expands 1,700 times—that is to say, in common atmospheric pressure; but let us go on to 90 pounds pressure in a steam boiler, which is:

Six atmospheres	90
Add main atmosphere	15
	105 pounds.

"A well constructed boiler, under the management of a careful man, is able to evaporate from 12 to 14 pounds of water for each pound of coal used. . . . We will reckon, however, only 12 pounds of water per pound of coal, and the result is:

Expansion or pressure in pounds	1,700	
Deduct as above, steam	90	
Atmosphere	15	105
		1,595

"This 1,595×12 pounds of water is equal to a power of 19,140 pounds for each pound of coal consumed with our present system of boilers, and I am under the impression that we are able to do better."

The above forcibly calls to mind the old quotation:

"A little learning is a dangerous thing;
Drink deep, or taste not the Pierian spring."

In the first place, a well constructed boiler, under the management of a careful man," is *not* able to evaporate from 12 to 14 pounds of water for each pound of coal. At the Centennial Exhibition, the highest evaporation of water per pound of coal, was, as we draw from the official reports before us, 8.927 pounds from the temperature of the feed. As the temperature of the feed was 68.94° Fah., the quantity of water evaporated from and at 212° Fah. was 10.34 pounds per pound of coal. To evaporate 13,233.6 pounds of water at a pressure of 70.059 pounds, from feed-water of a temperature of 68.94° Fah., required 1,482.35 pounds of coal, of which 153.25 pounds were ashes; so that the pounds of water evaporated per pound of *combustible*, from feed at 212° Fah., was 11.53.

Another boiler gave slightly better rating when reduced to pounds of water from and at 212° Fah. per pound of combustible; the figures being as follows: Coal used, 3,053.9 pounds; ashes, 320.2 pounds; steam pressure, 69.94 pounds; temperature of feed-water, 64.59° Fah.; water evaporated, corrected by calorimeter tests, 27,146.89 pounds; pounds of water per one pound of coal from temperature of feed, 8.89; pounds of water per one pound of coal from feed at 212° Fah., 10.35; pounds of water per one pound of combustible from feed at 212° Fah., 11.565. The lowest of these tests was 9.313 pounds of water per pound of combustible from feed at 212° Fah.

The above figures should correct the statement that an evaporation of 12 to 14 pounds of water per pound of coal is common practice with good management.

The next point we will consider, is the manner in which volumes and pounds are treated as the same things in the remarkable calculations of the *Brewers' Journal*. After saying that "water evaporated into steam expands 1,700 times—that is to say, in common atmospheric pressure" (which is less than 15 pounds above vacuum), he proceeds to consider the 1,700 *volumes* as so many *pounds;* and then from these 1,700 *volumes* (which he calls *pounds*, representing the pressure at one atmosphere), he proceeds to subtract 105 pounds, to show the pressure at 6 atmospheres.

The "net pressure," he then very gravely asserts to be 1,595 pounds (supposedly pounds per square inch). This he proceeds to augment twelvefold by multiplying by the number of pounds of water which one pound of coal will (according to his statement) evaporate, leaving "a power of 19,140 pounds for each pound of coal consumed with our present system of boilers;" and, says the *Brewers' Journal* scientist, "I am under the impression that we are able to do better."

It is exceedingly doubtful if we could do worse. To correct the impression which the publication of this monumental specimen of absurdity, without comment or criticism, by the *Miller and Millwright*, may have caused, we give below a correct statement of the quantity of water which may be evaporated per pound of coal, the volume that it takes up at various temperatures and pressures, its pressure at various temperatures, and the amount of work that it will do.

At a pressure of one atmosphere, or 14.7 pounds per square inch above vacuum (=zero by the gauge), one cubic foot of water forms, according to Regnault, 1,641.5 cubic feet; and according to Nystrom, 1,740 cubic feet. At 75 pounds above vacuum, equal to 60.3 pounds by the gauge, its volume is, according to Regnault, 348.15; according to Nystrom, 355.8. At 100 pounds absolute (=85.3 pounds by the gauge), it takes up only 267.8 cubic feet, according to Regnault, and 269.4 according to Nystrom.

The temperatures are, at one atmosphere (=14.7 pounds above vacuum = zero by the gauge), 212°

Fah.; at 75 pounds, absolute (=60.3 pounds by gauge), Regnault gives the temperature as 307.42° Fah.; and Nystrom, 309.8° Fah. At 100 pounds absolute (=85.3 pounds by the gauge) Regnault places the temperature at 327.6° Fah.; and Nystrom at 329.9° Fah.

According to D. K. Clark, one pound of coke will evaporate 14.02 pounds of water from and at 212° Fah.; perfectly dried wood, 8.07; wood charcoal, 13.13; British coals (average), 14.63; petroleum, 20.33 pounds.

These values are taken from the number of heat units which these fuels contain. The averages of 60 trials at Wigan, showed 10.31 pounds of water evaporated at 212° Fah. per pound of coal with double flue boilers; and 10.34 pounds with conical water tube boilers. The best results obtained were 10.86 pounds at 212° Fah., with double flue boiler; and 10.58 pounds with the conical water-tube boiler. By the addition of an "economizer," the duty of the double flue boiler was brought up to 11.56 pounds at 212° Fah. per pound of coal; and 11.82 pounds with the conical water-tube boiler.

All the above results were at one atmosphere pressure. Under an effective pressure of 40 pounds per square inch the amount of water per pound of coal was, of course, less, being 9.53 pounds instead of 10.76.

The Motive Power of the Future.

If we read aright the signs of the times, the industrial world is to-day standing on the threshold of a revolution as profound as that which was ushered in with the advent of steam as a motive power. From all quarters we hear of new advances in the modes and appliances for generating and utilizing electricity for the most diverse purposes; and enough has been achieved within the past few years to render it almost certain that the close of the present century will find it as universally applied in the arts and industries as is steam at the present time.

From the calculations of one of the most distinguished English scientists, it would appear that the world has used up during the past hundred years more of the energy stored up in the earth than in all the ages that have preceded them. This assertion, startling as it may seem, does not appear unlikely or overdrawn when we come to figure up the enormous yearly drains made upon the stored up energy of the earth by the ever expanding demands of the arts and manufactures. In all civilized countries the annual consumption of coal is steadily on the increase. In the year 1881, the estimated production of coal in Great Britain alone was 150,000,000 tons; in 1880 it was 140,000,000; and in 1877 the annual out-put was 125,000,000. We have here an average yearly increase of 6,500,000 tons. The yearly production of Germany and Austria is estimated at 73,500,000 tons; that of France and Belgium, 32,000,000; and for the other countries of Europe the aggregate is figured at 6,500,000 more. Adding these quantities together, we have a yearly production for Europe alone of 262,000,000 tons. Turning to this country, we find the annual production of anthracite coal in 1881 reached the hitherto unprecedented figures of 30,000,000 tons, while that of bituminous and other forms of fossil fuel was not less than 40,000,000, giving a total of 70,000,000. Adding together these figures, we have the grand aggregate of nearly 350,000,000 tons of coal, representing the world's consumption for one year.

There is no danger, even with these enormous quantities, and providing for their increase at the same rate at which they have increased in the past, that the supplies of this fuel will give out for centuries to come. But one of the most noticeable things in connection with these facts, is the enormous wastefulness of our methods of mining and consuming coal. Every ton of coal put into the market represents a ton left in the mines, or at the breakers where it is prepared for use; and from every ton of coal consumed we have thus far been able, even with the most approved appliances, to realize scarcely one-quarter of its stored up energy, measured by the amount of work we are able to get from it.

It will be apparent from these statements that it is only the abundance of the material that makes it available as a source of power. Were it otherwise than plentiful, the enormous wastefulness attending its production and use would make it valueless to us.

There are, besides all this, serious objections that necessarily accompany the use of coal as a source of power. It is bulky, and requires enormous labor to transport it to market. It gives off vast volumes of deleterious gases and soot in its combustion, which poison the atmosphere, and it leaves behind vast quantities of ashes which must be laboriously removed.

As regards steam, through which the stored up energy of coal is made available for doing work, the apparatus and machinery necessary for employing it are cumbersome and expensive, and the steam boiler, which is as necessary to the smallest steam engine as to the largest, is no freer from the danger of explosion than a century ago.

From all these disadvantages and drawbacks electricity is free. Silent, rapid and powerful, it makes no dirt or ashes, evolves no noxious gases, may be transmitted over incredible distances without serious loss, through small metallic wires, that when once in place require nothing for their maintenance, and yield us light as well as power.

When the vast natural resources of power—the wind, the waves, the tides, the river currents and waterfalls—are considered, that are now allowed to run to waste, a faint idea is had of the possibilities that are within the grasp of mankind, and that doubtless will be realized by future generations. When these enormous and exhaustless floods of wasted forces are coerced into the service of man and made to do his bidding, the aggregate of power at his disposal will be almost infinitely increased over what it now is; nor will he be using up the world's energy the more speedily, for the sun will be its perpetual regenerator.

The utilization of some of these natural forces on a large scale, with electricity as the agent for transmitting and developing their energy, is among the possibilities of the immediate future, and no one can foretell the magnitude of the changes that it may be destined to carry with it.

Project for Supplying Water to New York and other Cities of the Hudson Valley.

We have received and read with much interest a "Report on a Water Supply for New York and other Cities of the Hudson Valley," made to the associated proposed incorporators of the New York and Hudson Valley Aqueduct Co., by Col. J. T. Fanning, the chief engineer, and by them approved and accepted. This report, which embraces the facts of an extended survey of the region involved, and which is accompanied with a map, drawings, statistical tables, etc., relates to the project of supplying New York and other cities and towns of the Hudson valley with water brought from Lake George.

The scheme is sufficiently ambitious to warrant the designation of "magnificent." It would certainly be highly desirable, and that it is not visionary, a reading of the report, or of the following condensed abstract of its more important contents, will suffice to show. From the report we glean that the altitude of low water in Lake George is 322 feet above mean tide at New York. The distance from the proposed outlet of the lake to the Harlem River, on a feasible aqueduct line, is about 225 miles. The lake has somewhat more than 3,000 square miles of watershed, and it is assumed that by the aid of a short canal the waters of the tributaries of the upper Hudson could be led into the lake to reinforce the reservoir.

Allowing for the requirements of the manufacturing and canal interests at Glen's Falls and below on the Hudson river, Colonel Fanning estimates that a total of 122 inches of rain may be collected annually for storage. Computing the minimum amount estimated for storage upon 3,000 square miles of the upper Hudson watershed, it gives 1,391,672,430 gallons for daily average, which, with the surplus flow from the Lake George watershed, would make a daily average of 1,500,000,000 gallons available for the purpose of city water supplies. These figures in the preliminary estimate Colonel Fanning believes to be lower than the probable flow of water would warrant.

The water of Lake George, the report says, is well adapted for commercial and domestic purposes. The comparatively low temperature of the lake will protect its waters from superabundant growths of vegetable and animal life, the decomposition of which in ordinary ponds and reservoirs so much impairs the purity of the water.

It is proposed that the conduit shall be at the first construction an open canal with a capacity of 500,000,000 gallons a day. At Lake George it will be 322 feet above mean tidewater, at Yonkers 213 feet, and above the Harlem River 200 feet.

The report contemplates the ultimate covering in of the entire canal, which would materially increase its capacity for supply by lessening the amount of loss by evaporation during the summer, and by reducing the thickness of ice formed upon its surface in winter. It is proposed, also that it shall be paved throughout its entire length, and that special attention shall be paid to the smoothness of its sides, in order attain the maximum flow at all seasons. Occasional short tunnels will have to be built in carrying out the scheme, in order to reduce the length of the line by avoiding lengthy detours around prominent mountain spurs, as at the Fishkill mountains and Anthony's Nose.

Siphons will be required in several instances, and where the pressure exceeds twenty feet they will be of boiler iron in a series 72-inch diameter riveted tubes, in number according to the required delivery water. These tubes will be placed side by side, and the number will be increased as the demand for water increases. Stop gates, waste wiers, and waste sluices will be introduced as the topography of the line and other conditions shall make it desirable. The canal from the river to the lake will be of larger section than the conduit, so as to provide for the rapid storing of water when the flow of the river is above the average. The report says that the capacity of the canal can be readily and cheaply increased from time to time, as shall be required, by raising its banks. A raise of the flow line 16 inches will increase the capacity of the canal 100,000,000 gallons per day.

From the terminus of the canal, near High Bridge, the water will conveyed into the city by iron pipes. The report says that main pipes can be extended to Brooklyn and Jersey City, and also to Newark, if called for, and distributions can in like manner be made to the cities and towns along the line of the canal.

The approximate estimate of the cost for 210 miles of the canal is $26,250,000; seven miles of tunnel, $4,900,000; ten miles of siphon, $10,000,000: and the Hudson dam and canal, engineering, land, and water rights, and roofing and paving ten miles of the canal will bring the whole cost to $49,475,000. It is estimated that three years would be required for the construction of the entire work.

According to a table of the population in the vicinity of the conduit line that may share directly in its sanitary advantages, and in its financial and commercial benefits as well, there are thirty towns and villages besides New York and Brooklyn, together with which cities they contained in 1880 a population of 2,008,984. The present population is estimated at 2,089,821. From the map of the conduit it appears that branches may be built to supply Troy, Albany, Hudson, Red Hood, Poughkeepsie, Cold Spring, Peekskill, Tarrytown, Yonkers, and Westchester.

The "Union" Steam and Water Heating Apparatus.

The heating apparatus known under the above name, and manufactured by the H. B. Smith Company, of Westfield, Mass., is not presented here as a new device, having been before the public for the past fifteen years, but the record that it has made in that time has been so uniformly creditable to it, that we do not think our readers will regret the fact of our admitting an extended account of its main features in the columns of our journal.

The apparatus is so devised as to be susceptible of being extended or contracted, still retaining its characteristic features, so that it is equally well adapted to the requirements of private residences and public buildings for heating and ventilation. The following description covers the main points that distinguish it.

The entire apparatus is located in the basement or cellar at a point convenient for the intended purpose to the rooms to be warmed, where the latter may be reached by means of tin hot-air pipes branching from the chamber. The steam generator, together with as many stacks of "indirect radiators" as are required to heat the rooms, are placed in a brick chamber, which is built up to the hight of the beams, and lined with tin to prevent loss of heat by radiation. Inside of this chamber is erected the steam generator, shown in perspective in Fig. 1, with the brick chamber surrounding it partly removed, to exhibit details; and in partly sectional longitudinal view in Fig. 2. It is made of cast iron in separate sections, each of which is a complete boiler in itself, so that by using a greater or lesser number of these sections the capacity of the generator can be increased or diminished to adapt it to the size of the building to be warmed. The surfaces of these sections are evenly planed; they are connected together securely with short bolts, and the joints packed with a refractory material selected with special reference to its ability to withstand the action of steam and hot water. The steam and water connections not being in contact with the fire, they are thus rendered quite safe from the injurious action of the flame, and the escape of the gases of combustion into the chamber is effectually prevented.

The simplicity of construction which characterizes the steam generator, and the fact that the fire is entirely surrounded by water, except at the grate, are special advantages on the score of convenience and safety. One of the advantageous results of this arrangement, is that the graduation of the heat in mild weather may be perfectly controlled by simply starting a slow fire and heating the water in the boiler without getting up a steam pressure, and using the external surface of the boiler to warm the air, thus insuring the greatest economy in the consumption of fuel.

By referring to Fig. 1, the construction of the apparatus will be understood from the following: The engraving is a perspective view of the generator, with its connections, and surrounded with the brick chamber, a portion of the wall being removed to show the interior. In this engraving A represents the several sections of the steam generator; B, the indirect radiators; C, the damper regulator; D, the flue door; E, the feed door; F, the ash pit doors; H, the draft door; J, the damper; K, try-cocks; *c*, water gauge; M, safety valve; and R, hot-air pipes. Fig. 2 serves to show the form of the sections constituting the steam generator, and the manner in which the generator may be built up by sucessive additions of these sections. The rooms that are farthest away from the steam generator can be warmed by outside stacks of radiators, placed at the bottom of the hot-air flues, and connected with the generator by proper sized supply and return pipes, or by direct radiators in the rooms. To insure a proper supply of fresh air to the rooms, a cold-air shaft of wood or brick is run into the bottom of the chamber surrounding the generator, from the outside of the building.

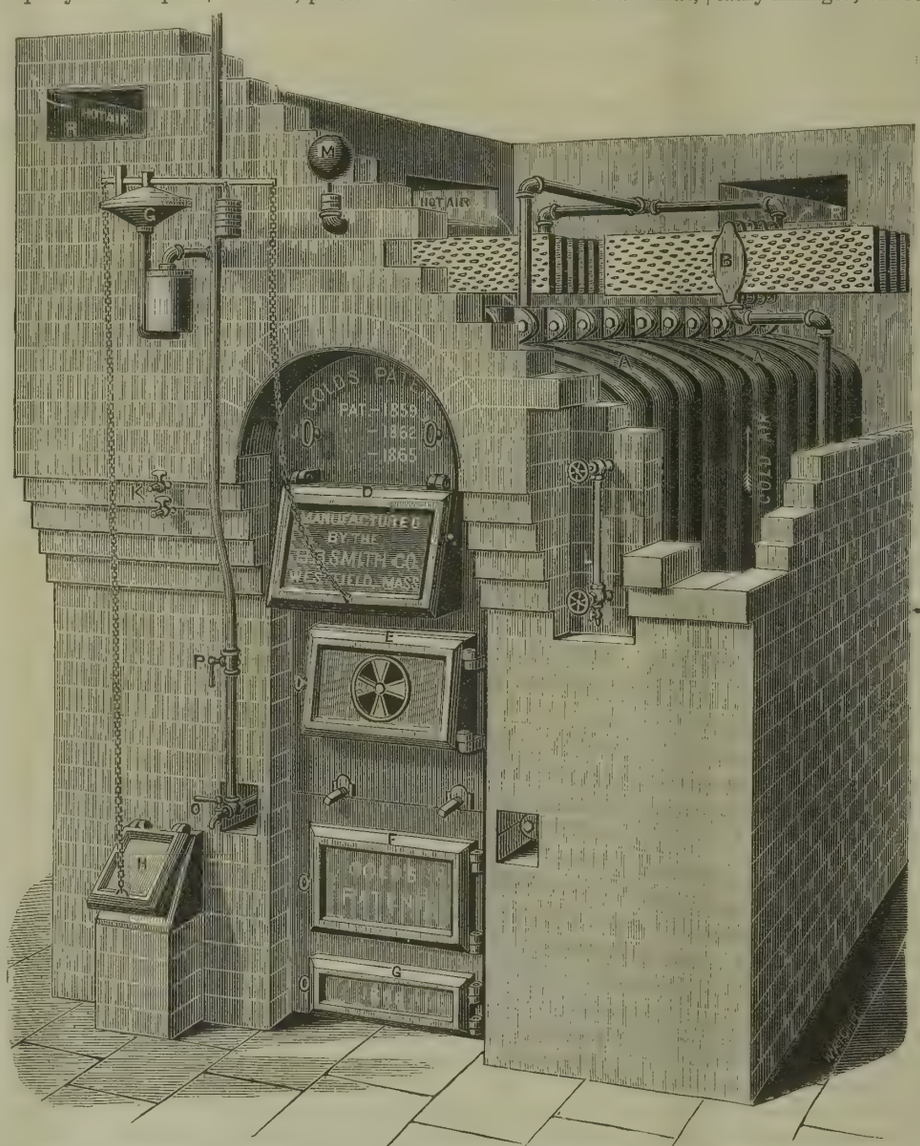


Fig. 1.—STEAM GENERATOR IN BRICK CHAMBER, WITH CONNECTIONS.

The radiators, which are also made of cast iron, are so constructed, by the distribution of a large number of conical points or pins over their surfaces, (which increase their external surfaces to fully three times that of the inner), that the heat is liberated at a much more moderate temperature than that of the steam within, imparting to the air, in consequence, a moderate and genial warmth without dessicating it by the excessive heating.

The generator is arranged with both shaking and dumping grates, to provide against the annoyance caused by the formation of clinker, and to obviate the necessity of using pokers and slice bars, and of opening the fire doors, except to replenish the fuel as it is required. The cleaning is done through the ash pit door, which insures economy both in fuel and labor of attendance.

As remarked at the outset, this form of apparatus, with unessential modifications to adapt it to various conditions of practice, has been in use for a number of years, in schools, public buildings and private residences, in all parts of the country, and has maintained, so far as facts have come to our knowledge, a high reputation for excellence.

The following are among the chief claims of excellence made by the manufacturers for this apparatus, namely, that it is absolutely safe from fire, durable, easily managed, self-regulating, efficient at low pressure, and economical. They add, further, that it does not vitiate the air, that it secures uniform temperature; that it operates without noise, and is free from gas or odor.

The offices of the makers—the H. B. Smith Co.—are, at the time of this writing, located at 8 Dey street, New York, but after the 1st of May will remove to 137 Center street.

Johns Asbestos Products.

Mr. H. W. Johns, of the well-known manufacturing company bearing his name, to whom we have previously referred in this journal as the pioneer in the utilization of asbestos for various useful purposes in the arts, by reason of his many ingenious and improved methods of manufacturing and manipulating asbestos, and his enterprise and perseverence in keeping his products constantly before the public, has succeeded in securing the extensive introduction of asbestos products of the most varied character, and in establishing an immense business devoted exclusively to their manufacture. The magnitude of the undertaking that Mr. Johns has brought to a successful issue will perhaps be better appreciated when it is stated that less than ten years ago manufactured products of this material were comparatively unknown, and the mineral itself of no interest to any one outside of the cabinet of the mineralogist.

Its qualities and properties are so peculiar that it is not surprising to find that one useful application followed another speedily after its utilization was once undertaken. It is not only practically indestructible by fire and acids, but possesses a preëminently fibrous texture, in virtue of which some of the finer varieties of the mineral may be spun, woven and felted, yielding cloth, felted sheets, paper and the like; while the common varieties may be reduced by suitable means to the condition of a pulp nearly resembling cotton or wool, in all of which forms it retains its peculiar fibrous and binding quality. The finer varieties of the mineral which possess long and strong fibers, white in color and silky in texture, being quite free from mineral impurities that impair the flexibility of, and give a harsh and brittle character to, the commoner varieties, are comparatively rare, and are consequently somewhat expensive; while the common varieties,

though they do not possess the exquisitely fine texture of the others, have nevertheless been found to be susceptible of many useful applications, by ingenious methods and appliances brought to bear upon them in the course of their manufacture. The growing demand for the article, which of late years has sprung up as a consequence of the widely extended introduction of asbestos products, has resulted in the discovery of the mineral in vast quantities in various parts of this and other countries. For much of the interest which has been attracted to the utilization of this substance, we are indebted to the energy and intelligence of Mr. Johns, and chiefly to the admirable quality and utility of the numerous products which he has succeeded in manufacturing from it.

Many of the products prepared from asbestos by Mr. Johns are already familiar to our readers from previous comments made upon them in this journal, on which account we shall devote the major portion of the description which follows to an account of such of these products as are not so generally or so well known as their merits deserve.

Of these, the so-called asbestos mill-board is deserving of special mention. We are familiar with several efforts made by different parties to produce this material, but none of them approach in quality that of which samples have been submitted to our inspection by Mr. Johns. The superiority of this product no doubt is largely due to the purity of the asbestos employed in its manufacture; and the examination which we have given to the specimens submitted to our inspection, has satisfied us of the correctness of Mr. Johns' claim that he uses in its production only "pure asbestos of the finest quality and strongest fiber."

The mill-board, as we glean from the catalogue of the manufacturers, is made in flexible sheets 40 inches square and from $^1/_{32}$ to $\frac{1}{4}$ of an inch in thickness, weighing from $1\frac{1}{2}$ to 12 pounds. It is practically proof against fire and acids, and the claim is made for it that it forms the most durable flat packing, or jackets or gaskets, in use for flange joints, cylinder heads, manhole plates of steam boilers, oil stills, hot-air joints, steam pumps, and the like. It is recommended also as an excellent covering for locomotive boilers, caloric engines, and as an efficient protector for all surfaces against the action of fire. The asbestos board will adapt itself to any irregularities of surface by reason of its flexibility; and it is claimed for the product that it will wear ten times as long as any other flat packing, that it is unaffected by long exposure to heat, and forms a sound and permanently tight joint, which may be removed and replaced without injury. The H. W. Johns Manufacturing Co. furnish asbestos gaskets of all sizes not exceeding 40 inches in diameter, and from $^1/_{32}$ to $\frac{1}{4}$ of an inch in thickness, cut to order from the asbestos board above described. These gaskets weigh less than one-half as much as those made of India rubber.

The asbestos wick packing is another useful product of this company that is worthy of special notice. This product is made from the purest, long fibered asbestos, spun and twisted in the form of a soft, strong lamp wick, and which can be wound or packed in any desired shape around small steam and other valve stems, pumps, etc. By reason of its fire-proof quality and its indifference to the action of acids, it is recommended as being especially valuable in chemical works.

Their improved pure asbestos rope packing, recently perfected as patented, is a marvel of simplicity and perfect adaptability for its purpose. In appearance it is a perfectly molded, smooth, cylindrical rope, which, although very compact, is perfectly flexible, and with slight manipulation can, if desired, be made as soft as the common hemp packing. The strands of this rope may be readily separated or combined to fit stuffing boxes or joints of any size or shape, and is confidently claimed to be by far the most durable packing in use for piston rods, valve stems, throttle valves, pumps and stuffing boxes of high and low pressure engines, etc. The asbestos is self-lubricating to a certain degree, hence the packing will demand less oil, for which reason, in connection with its eminent durability, it is highly economical as compared with other packings, and as it can evidently be produced at a less cost than the braided, covered or other forms of rope packing, we predict for this article that it will become the standard steam packing of the world.

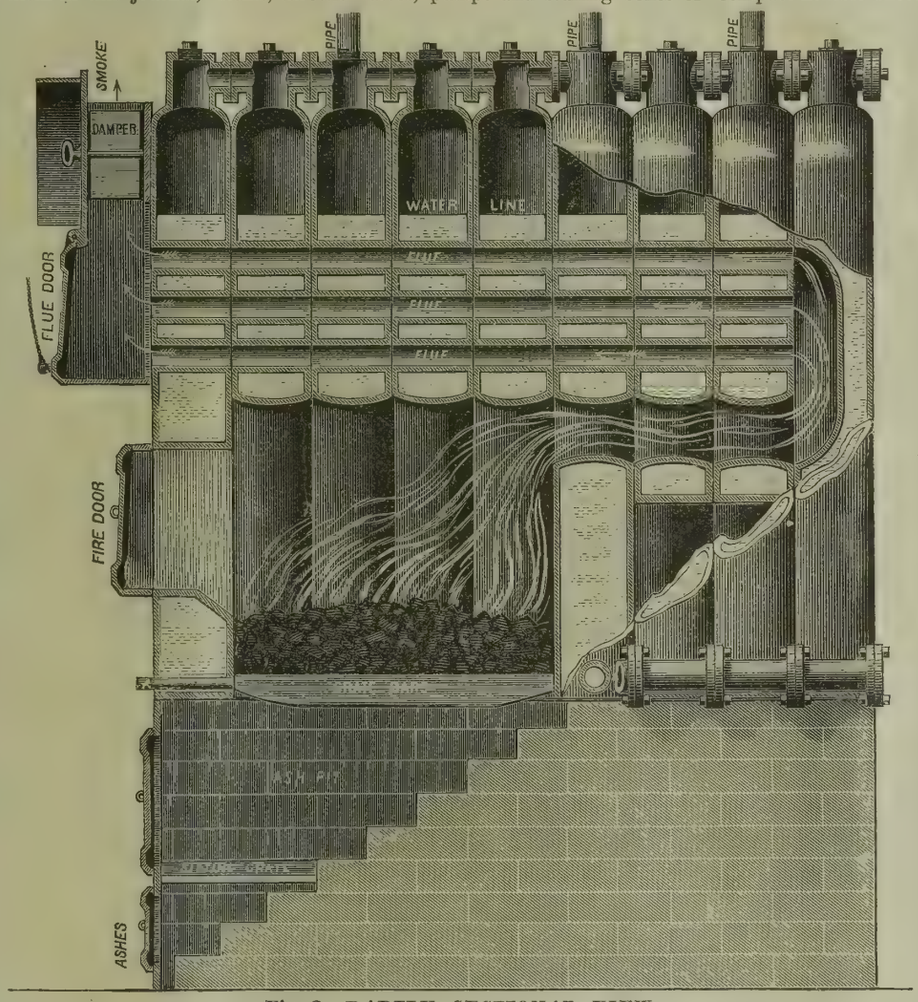


Fig. 2.—PARTLY SECTIONAL VIEW.

The asbestos boiler and pipe covering of this company is better known than the above named products. It is applied in a variety of ways, according to circumstances or the desire of the user. It is employed either as a cement felting, composed of fibrous asbestos and a cementing compound, which forms a light, porous cementing covering, or it may be applied with a trowel directly to the steam pipe or boiler to be covered, while it is heated. Another variety of the covering is in the form of the so-called asbestos lining felt, made of a pure asbestos sheathing, to one side of which is attached flocked (or pulped) asbestos. This material is furnished in sheets and rolls of any desired width, and is intended to be used in place of hair felt, or under hair felt, on steam pipes, boilers, etc., forming a heat insulating lining, which affords the hair felt a decided protection against the injurious effects of heat. In other forms of steam boiler and pipe covering Mr. Johns provides one or more air chambers.

Of the other asbestos products of this company, their roofing material and paints have already been described in these columns, but to complete the account of these manufactures we append a brief description of them to conclude our article. The asbestos roofing consists of a strong canvas, combined with a surface layer of felt and a manila lining. These materials are rendered water-proof and cemented together with intermediate layers of acid and water-proof composition, and the whole compressed into a compact flexible sheet resembling leather, forming a strong and substantial portable roofing. This, when applied and finished according to instructions with the asbestos roof coating and the white fire-proof coating, forms a light, cool roof, which although not claimed to be absolutely indestructible by fire, is proof against burning sparks and cinders, and in every instance which has come to our knowledge, has proven a safe protection where buildings covered with it have been exposed to fire. This roofing is adapted for steep or flat roofs of factories, foundries, warehouses, railroad buildings, bridges, car roofs, steamboat decks, etc. It is suitable for all climates and has been used in all parts of this country, and in South America and Europe, a sufficient length of time to warrant the claim of the manufacturers that it is the best and most economical substitute for tin in use. It can be easily applied, without the aid of skilled labor, it being necessary only to fasten it properly to the roof to make tight joints and laps, and to coat it thoroughly and evenly, which can be readily done by any intelligent workman—no heat or special tools being required. It is furnished ready for use in rolls about 39 inches wide, containing 200 square feet, and weighs, with coatings complete, only about 70 pounds to 100 square feet.

The asbestos liquid paints of this company, briefly, are claimed to be unsurpassed in richness and permanency of color, beauty of finish, durability, uniformity, and all characteristics which are requisite to form a highly ornamental protective covering. They possess a certain elastic quality, and are prepared ready for the brush, but may be thinned, if desired, the same as any oil paint. They are especially designed for dwellings and other exposed wood and iron structures, for which purposes they are claimed to be very economical and durable, comparing favorably in these respects with the best white lead, while they are equally valuable for inside work and for general purposes. The foregoing will suffice to give our readers an idea of the number, variety and importance of the products that have been obtained from asbestos. The list has not been exhausted, as those curious upon the subject may satisfy themselves by writing for the descriptive catalogue of the H. W. Johns Manufacturing Co., 87 Maiden Lane, New York.

Recent Improvements in Wood-Working and other Machinery.

Timothy L. Carley, of Syracuse, N. Y., has invented the improvement shown in Figs. 1, 2 and 3, relating to head blocks and dogs for saw mills. The following description will serve to explain the invention: The object which the inventor seeks to secure is to furnish a head block and board or plank dog, so arranged or combined as to be more easily used and do better work, more quickly and advantageously than those in ordinary use. The manner in which he seeks to accomplish these results will be understood by reference to Figs. 1, 2 and 3. Fig. 1 is a side view of part of the head block and the mechanism in position. Fig. 2 is a side view of the stake of the head block with slot in the same, in which the dog is moved up and down. Fig. 3 is a view of the detachable standard for supporting the dog and sliding head. A represents the head block upon which the timber rests when being sawed; B represents a plank which is being sawed; C represents the knee of said head block, which is curved at its top, and has an enlarged hub (represented at D), through which the standard E passes loosely into a hole or socket (represented at F), in the bottom of which there is a piece of rubber or other suitable material to prevent the metals striking each other. The standard E can be made of a round or square piece of metal. On E is a sliding head (represented by G), which easily slides up and down on the standard E, and raises or lowers the dog (represented by H), the latter working easily backward or forward horizontally in the said sliding head for the desired distance. This is done by having a mortise in H made long enough to give the desired lateral play. The dog H passes through a slot (represented by J) in the knee C, and can easily play or slide up and down therein.

Fig. 2.

The operation of the mechanism is substantially as follows: The dog is placed in the head block, and then the standard E is run through hub D and said sliding head and dog, the lower end resting in its socket F. The dog H engages the timber or plank to be sawed, as shown in Fig. 1, and then the sliding head drops a little and becomes eccentric with the standard, and consequently holds or locks the point of dog firmly in its engagement with the plank, while the saw passes through and makes two boards. The object of the dog is to hold the last board or plank when it is being sawed. When not in use, the dog has only to be drawn back and dropped down, when its point is in the slot J and is out of the way. The standard E can be fastened rigidly in the hubs D and socket F by set-screws or keys. The standard E serves to strengthen the knee C, and at the same time hold the dog in position and perform the other offices mentioned. Both the dog H and sliding head G can be clamped by means of set-screws or keys to the standard E, or to each other; but the inventor claims that this is unnecessary, as the dog is securely held as above described.

Fig. 4 represents an improvement in wood-bending machines, invented by George H. Preston, of Shortsville, N. Y. The special feature of this improvement consists in providing a better method of producing, holding and regulating the up-set or end-pressure upon the timber while it is being bent, thus enabling heavy as well as light timber to be bent without splitting, breaking or buckling.

The cut shows the improvement attached to a bending machine of the Blanchard pattern. It consists substantially of a spring follower applied to the bed or table which forms the bending lever of the machine. Ordinarily the pressure on the end of the timber is applied directly to the follower which communicates the pressure to the timber to be bent, and is unyielding; but by placing the spring-follower between the pressure and the timber G, the timber is allowed to adjust itself endwise sufficiently to make a perfect bend, and neither break nor buckle.

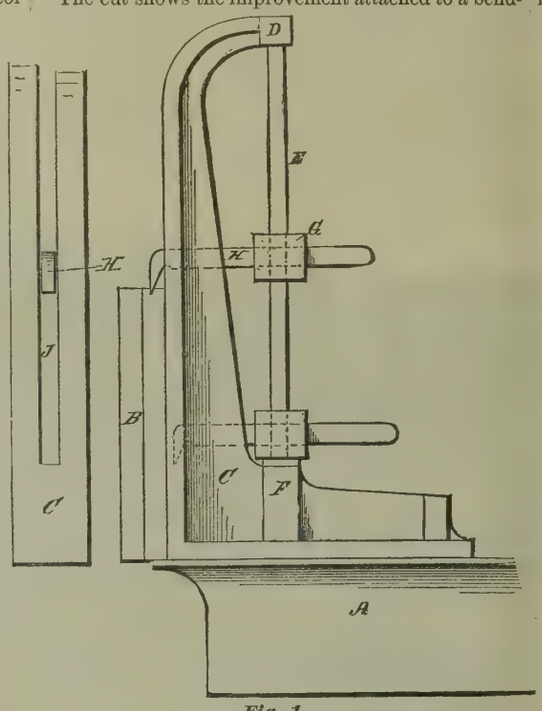


Fig. 1.

The operation of the machine is as follows: Place the form B (the strap A being attached to it) upon the shaft H, with the strap fastened directly at the bottom. Draw the bed E back so far that the bar J J will engage with the hooks P P. Place the timber G upon the strap A, with one end under the form, and place the follower D in its position against the other end of the timber. Apply a pressure to the spring-follower by turning the screw F sufficiently to loosen the nut K. If the tension of the spring is not right, it may now be adjusted by turning the nut K. It may be seen that the screw F will hold the spring to its proper tension while bending; but the bolt *t* prevents the spring from expanding when the screw is turned back, thereby saving the labor of turning the screw to compress the spring at each operation. When commencing to bend, see that the pressure applied by the screw F is sufficient to loosen the nut K. The form may then be turned till the timber is bent without any further attention to the up-set.

A flat steel spring with one or more angles in it, or a rubber spring, may be used instead of the coil spring.

An improvement in log rollers for saw mills, the invention of Joel Lucia, of Little Suamico, Wis., is shown in Fig. 5, in which A represents a suitable frame, through which passes an operating shaft B, on which is a pinion gearing into a rack for moving the lumber forward or backward; H is a pivoted lever, with a spur wheel L at its upper end.

The invention consists in a pivoted lever having a spur wheel journaled in its upper end, and having its lower end weighted, whereby, when the cross-heads are moved in one direction, the levers are made to roll the log forward toward the saw, and when moved in the opposite direction will allow their upper ends to be depressed so as to pass under the log and then spring back into place by the action of the weight.

It further consists in attaching to the cross-head a spring-catch, which, when the levers have their upper ends depressed, as when passing under the log, catch under the sides of their lower ends to hold the levers in nearly a horizontal position until released by the operator, all of which will be more fully described hereinafter.

Fig. 3.

The object of the invention is to dispense with the usual springs and other such appliances as have been attached to the lower end of these pivoted levers, and to make the levers automatic in their operation by making the lower ends of the levers heaviest, and to provide a means by which the levers can be thrown out of operation when so desired.

The operation of the invention is as follows: The log is placed upon the skids and rolled forward by hand to a point in advance of the driving shaft. The driving shaft is then turned so as to draw the cross-heads backward, and when the upper ends of the levers come in contact with the front side of the log the levers turn freely upon their pivots, and their lower ends are depressed sufficiently to allow them to pass underneath the log. When the levers sink down just far enough for the wheels to pass underneath the logs, the spring-catches do not interfere with the levers, and as soon as the wheels are passed under the log the weighted ends of the levers cause their upper ends to rise upwards in the rear of the log. When the shaft is turned so as to move the cross-heads forward, the sharp projections on the wheel catch against the sides of the log and roll them forward toward the saw. When it is desired to throw the levers out of operation, it is only necessary to raise their weighted ends upward far enough to enable the spring hooks or catches to keep under their lower edges, when the upper ends of the

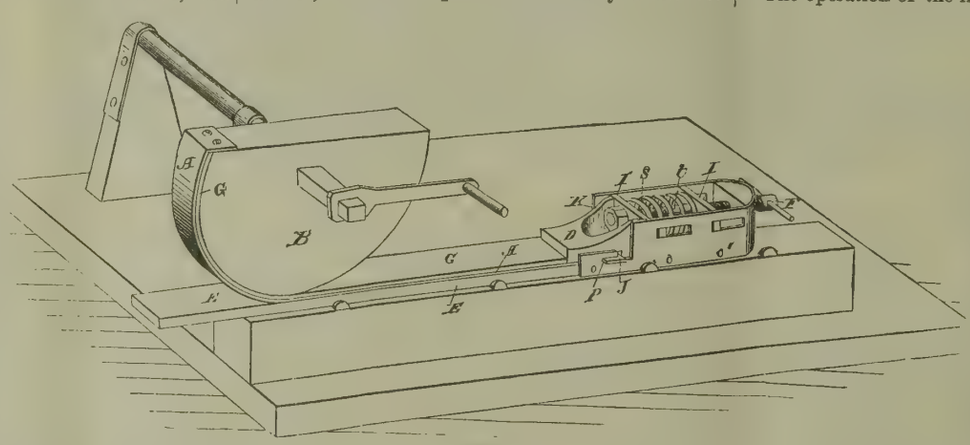


Fig. 4.

levers will be held down out of operation until the spring hooks are moved backward, so as to leave the levers free to operate.

Heretofore pivoted levers provided with wheels have been used; but they have been attached to springs and other such devices for drawing them back into position again after they have been depressed by the logs; but this construction is both troublesome and expensive. By weighting the levers they are made automatic in their operation, and the cost of the machine is greatly cheapened.

Figs. 6, 7, 8 and 9 show an improvement in saw swages, invented by Furmon S. Smith, of Woodville, Mich., the object of which is to facilitate the setting and swaging of the teeth of cross-cut and other saws in a manner that improves the accuracy of the set and the shape of the teeth. The invention consists in constructing a saw set and swage with a handle, a center piece formed upon the handle and having a groove and a recess upon each side, side pieces placed upon the opposite sides of the center piece and having shoulders and angular notches upon their inner sides, and the band that fastens the side pieces to the center piece and handle.

Of the cuts, Fig. 6 is a side elevation, Fig. 7 an edge elevation partly in section through the line *x x*, Fig. 8 is a side view of a portion of a saw, and Fig. 9 a cross section of the same through the line *y*. A is the body or center piece of the saw set and swage, which is formed upon the forward end of the handle B, and is tapered upon its opposite sides and edges toward its forward end, as shown in Figs. 6 and 7. Upon the opposite sides of the center piece A, at the forward end of the handle B, are formed wide and shallow cross grooves C, with shallow concaves D in the bottoms of the grooves C. Into the angles between the sides

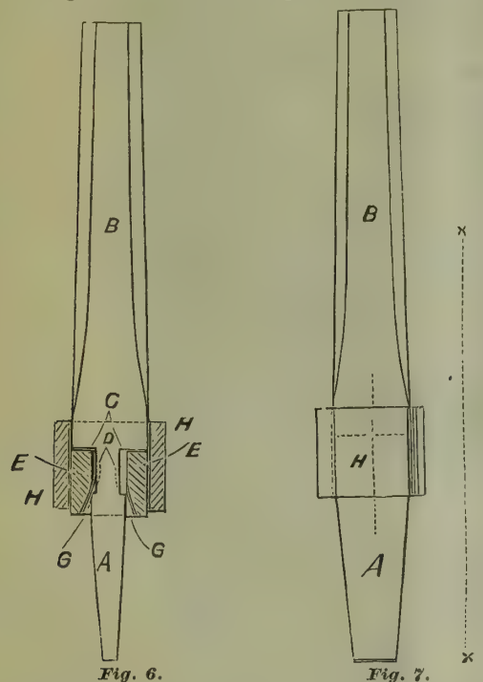


Fig. 6. Fig. 7.

of the center piece A and the forward end of the handle B are fitted blocks or side pieces E, which have shoulders formed upon their inner sides to fit into the grooves C of the said center piece A. In the inner sides of the forward ends of the side pieces E, are formed tapered angular notches G to receive the saw teeth. The notches G extend past the shoulders to allow the points of the saw teeth to pass the shoulders of the grooves C and enter the recesses D. The side pieces E are secured in place by a band H, driven upon them and upon the forward end of the handle B, as shown in Figs. 6 and 7. The groove C and recess D upon one side of the center piece A are made deeper than the groove and recess upon the other side of the said center piece, so that the tool can be used to give a finer or coarser set to the saw teeth, as may be required.

In using the saw set and swage, the saw is placed

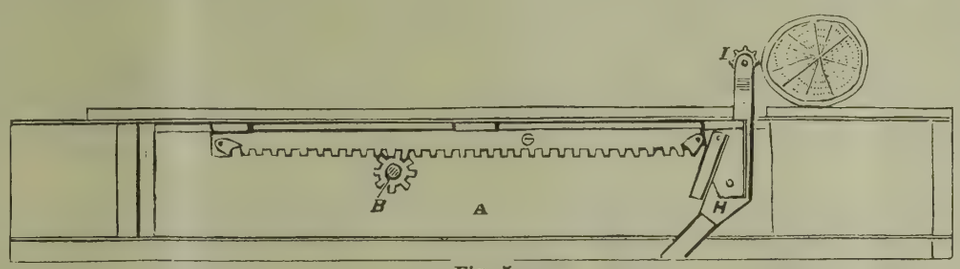


Fig. 5.

in some suitable support, with the teeth upward. The tool is then placed successively upon the saw teeth, and one or more blows with a hammer upon the end of the handle B properly swage the teeth at the time they are set

Fig. 10 represents an improvement in saw sets, in-

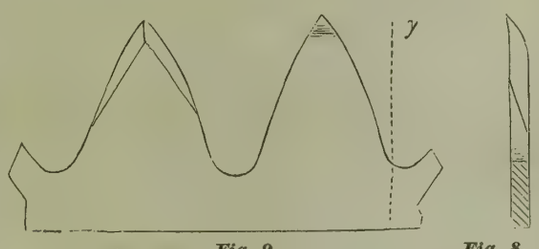


Fig. 9.

Fig. 8.

vented by John M. Draper, of Philadelphia, which relates especially to that class of saw sets in which the setting of the teeth is effected by the striking action of a die. It will be understood from the following description, in which reference is made to Fig. 10. The saw to be set is placed between the platform I and the disk K, and clamped therein by turning down the screw K. The platform I is adjusted to a proper inclination, according to the set desired for the saw teeth, and the gauge H also adjusted according to the length of such teeth. In setting a tooth, the die is raised by moving back the handle E and then suddenly releasing it, thus producing a quick stroke of the die under the influence of the spring E'. When one tooth has been set, the saw is moved lengthwise to bring another into position, the disk K turning without loosening its clamping action, and thus permitting such lengthwise movement of the saw while holding the latter still clamped. Where a saw too wide to pass between the screw K, and gauge H requires to be set, the screw and the disk K may be wholly removed.

Petroleum Fuel for Locomotives.

Some interesting experiments have lately been made in this city upon the use of crude petroleum as fuel for locomotives, the special object of the same being the trial of a plan for the purpose devised by Mr. William B. Dickey, of the Albany Iron Works, New York.

With the apparatus of Mr. Dickey, a practical test was made upon an anthracite coal-burning engine on the New York, Woodhaven & Rockaway Railroad, which is reported to have been quite satisfactory, both as to the efficiency of the fuel and its economy as compared with coal. The trial trip was made to Rockaway and return, a distance of 33 miles. About 70 gallons of crude petroleum were consumed on the round trip, costing $1.20 as against $2, which represents the usual consumption of coal for the same performance.

We append herewith a brief account of the method employed by Mr. Dickey, which, so far as we glean from the description, involves no novel feature. The petroleum is driven into the fire space in atomized form by means of a jet of superheated steam, a plan that has been frequently and successfully practiced. Mr. Dickey's plan is described as follows: The petroleum in its natural condition, and at its normal temperature, is conducted from a convenient tank by a pipe, and delivered at the front of the fire chamber through a small nozzle. As it issues from the nozzle it is met by a jet of superheated steam, under high pressure, which passes at right angles across the oil nozzle, and is thereby thrown into the combustion chamber in a fine spray. The steam nozzle is so formed as to act as an air injector, whereby the steam, in passing through it, draws after it a current of air, which is minutely distributed throughout the oil spray. There are thus produced the requisite conditions for instantaneous, rapid and perfect combustion of the oil without smoke.

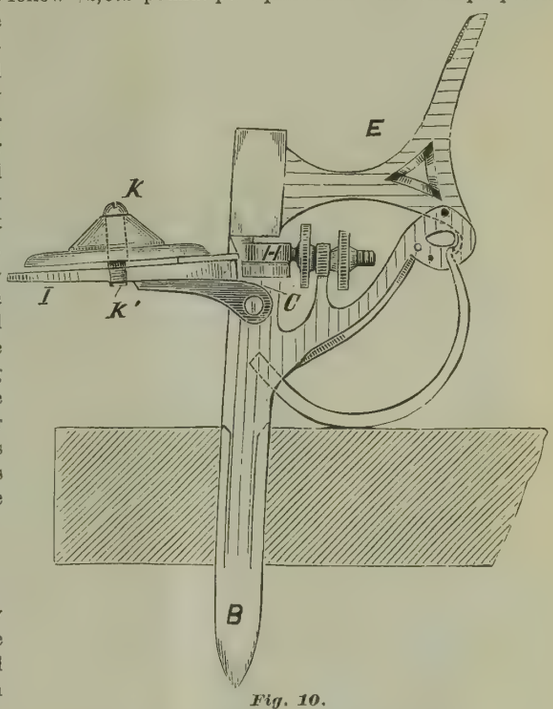


Fig. 10.

Chrome Leather.—Experiments show that the new chrome leather—the result of the new tanning process by bichromate of potash—exceeds in tensile strength the bark-tanned article; also that after it has set under the necessary stress, it still retains an extraordinary amount of elasticity, which is available for tightening belting on pulleys. As illustrating this statement, the fact is shown that a piece of chrome leather bore an ultimate stress of 3,297 pounds per square inch, while a piece of bark leather only bore an ultimate stress of 2,672 pounds per square inch—this example proving the samples of chrome-tanned leather to be stronger than the bark-tanned by some fifteen per cent.

Fine Drilling.—Professor Edward C. Pickering, of Harvard College, says that, in undertaking to measure the intensity of the light of the satellites of Mars, he had occasion to need an extremely small hole. A hole about the *twenty five-hundredth* part of an inch in diameter was finally secured.

Gregg's System of Brick Making.

The strong prejudice existing among the hand-brick makers against bricks made by steam machinery, as in every other industry where improved methods have supplanted the old and crude methods of the past, is gradually yielding and giving way before the inexorable logic of facts. The numerous failures in the attempts of inventors to produce a reliable brick machine, have proved a great drawback to rapid progress in this branch of the useful arts, for, until within a comparatively few years, no machine of this class had been devised that entirely fulfilled the expectations and claims of the inventor, or satisfied the demands made upon it in practical operation. Of late, however, so much real progress has been made in the construction of brick machines by their substantial improvement, that the old and tedious process of making bricks by hand is being rapidly superseded by the introduction of machinery, and bids fair in the course of a few years more to take its place among the many other discarded crudities which the march of improvement has committed to the store-house of abandoned arts.

In the development of brick making by machinery, the Greggs—father and son—have earned a high and deserved reputation for their numerous and valuable improvements in brick machines, and in presenting the following descriptive matter relating to the improved machine of Mr. William L. Gregg, we have only to remark that in its present form it represents the latest and most approved mechanical construction, and is the latest development of a series of machines which have been successively modified as improvements were called for in practice. Before proceeding to the description of the "Gregg Triple-Pressure Brick Machine," by which name the inventor distinguishes it, we may profitably add a few words in explanation of the several types of brick machines, which will enable us to better understand its distinctive character and principle of action.

In attempting a classification of brick machines, we may make a general division into "die" and "mold" machines; those of the first class forming, by means of a die or its equivalent, an exuding bar or slab, which is cut off by wires or knives into blocks of the proper lengths to make bricks of uniform size. The mold machines, on the other hand, form each brick in a separate mold. The latter again are divided into dry-clay machines, slush machines, and crude or moist clay machines, which names designate the character of the material on which they operate.

In making bricks by machinery satisfactorily many difficulties had to be overcome by the pioneers in this field of labor. These difficulties were found to be especially serious when it came to the production of face or front bricks. The trouble which required to be met and overcome arose from the fact that it has been found practically impossible to supply an equal amount of clay to each of the mold boxes, from which there results bricks of unequal size and density. Moreover, when but a single pressure is imparted to the clay, as has hitherto been the practice, the bricks are often found to be deficient in strength, especially at the corners and edges, and hence quite unsuitable for use as first quality face or front bricks.

As the result of a number of years of study and experiment to overcome these difficulties, which appeared to be insurmountable with the mold type of brick machines, Mr. Gregg has devised a modified system of mechanical action in their operation, and has embodied his ideas in concrete form in the machine here illustrated, and which is known as Gregg's triple pressure and combination brick machine.

The mechanical construction of these machines is such that the heavy "developing" pressures take place when the mold table is at rest, thus greatly reducing the power required to run them, and avoiding excessive strains in the machine and the danger of breakage.

From the peculiar construction of dry-clay machines where "filler boxes" or graduating measures are used to fill the mold boxes, the clay must be dried and granulated to fill with any degree of regularity into the filler boxes, and thence into the molds. And when molds are grouped together it becomes a physical impossibility by the dry-clay system to fill them alike, hence those deficient in clay will but partially develop the bricks; this, added to the fact of the cohesive quality of the clay being destroyed by extracting the moisture before molding, complete vitrification cannot take place in the burning, and the

Fig. 1.—MIXING MILL.

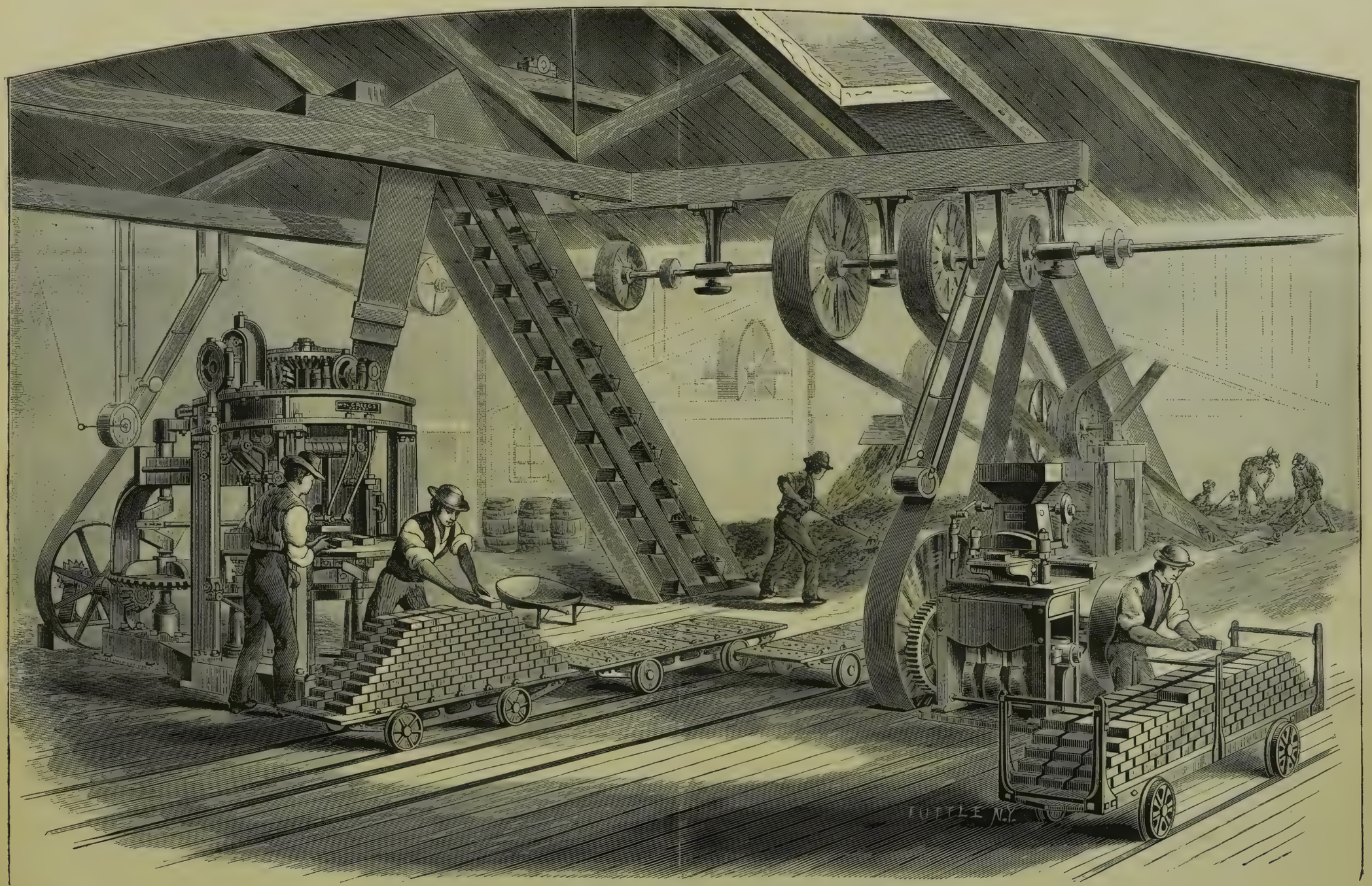


Plate I.---GREGG'S SYSTEM OF BRICK MACHINERY.

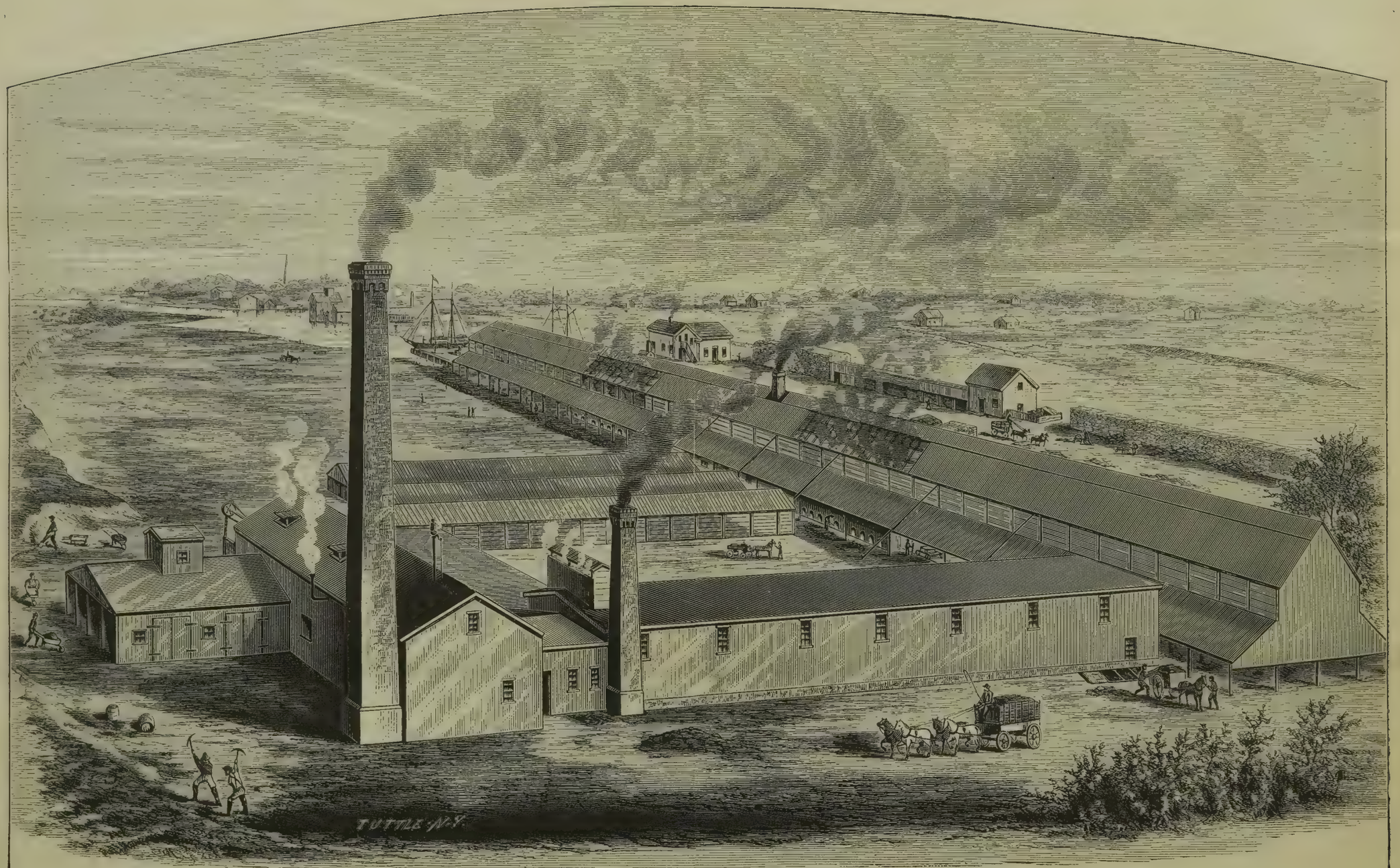


Plate II.---GREGG'S SYSTEM OF MAKING BRICKS BY MACHINERY.

result is that bricks made from dry clay disintegrate with the action of the elements.

In the manufacture of slush brick the other extreme is met. To facilitate molding in the hand way a large proportion of water is added, and the bricks being so soft must be spread upon floors to dry. The slow out-door process of drying, or evaporation, is one of the most favorable processes for the hand-brick maker, but it requires the continuous insurance of favorable atmospheric influences and a continuity of fair weather, which practically can never be relied on.

Clay, to be made into bricks by hand molding, must of necessity be so wet that at least 25 per cent of water must be evaporated before it is safe to burn, so that in fact, in works producing 30,000 bricks per day, upwards of 23 tons of water have to be evaporated therefrom every 24 hours; the labor attending which being an expensive item, and the bricks being rendered porous by the operation.

Gregg's triple pressure and combination brick machines occupy a medium position between dry-clay and slush machines, and a first great saving is effected, as the machines accept the crude clay and manufacture it to advantage in so stiff a state as not to contain more than one-eighth of the above amount of water to be evaporated, and yet all of its cohesive qualities are retained. The bond between the particles after burning is perfect, and the bricks are less porous, consequently stronger and absorb less moisture when burned.

Our illustrations give an excellent idea of a plant for manufacturing bricks on a large scale with these machines. Fig. 1 represents a form of mixing mill used in connection with the machines for mixing and tempering the clay. Of the full-page illustrations, Plate I. shows the appearance and disposition of the machines, and the manner in which they are driven. The machines are shown in operation, the finished bricks as fast as made being piled upon convenient carriages running on rails, and from time to time wheeled away to be hacked before entering the kiln. Plate II. is a perspective view of a complete establishment for operating the Gregg system on a large scale.

One of the merits of bricks made by the machines above described, is their superior strength as compared with hand-made bricks. We append a series of comparative tests of this kind which are represented to have been obtained in experiments made under the direction of the Supervising Architect of the United States:

1st	Hand made, front, whole, crushed	42,000	pounds.
"	" half, "	40,000	"
"	" quarter, "	30,000	"
2d.	Machine made, front, whole, "	60,000	"
"	" half, "	57,000	"
"	" quarter, "	55,000	"
3d.	Hand made, hard, whole, "	49,000	"
"	" half, "	32,000	"
"	" quarter, "	12,500	"
4th.	Machine made, hard, whole, "	55,000	"
"	" half, "	55,000	"
"	" quarter, "	45,000	"

The capacity of the Gregg machines is stated to be from 25,000 to 35,000 bricks per day. They have been largely introduced into the United States, and many millions of bricks that enter into public buildings, and other important edifices, have been made upon them. Ornamental bricks of any pattern can be made by modifying the molds for that purpose.

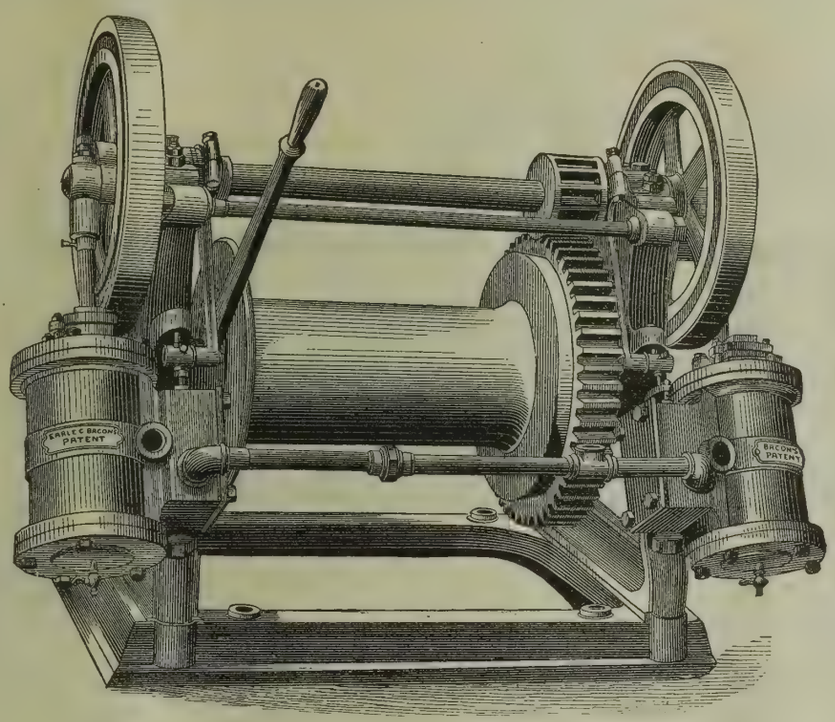
The machines have received the highest awards at the exhibitions of Vienna, Paris, and Philadelphia for strength, durability, simplicity of construction and perfection of product.

These machines are manufactured by the Gregg International Brick Machine Co., Equitable Building, Boston, Mass., U.S.A.

Bacon's Double-Cylinder "Special" Hoisting Engines.

The firm of Copeland & Bacon has long been well and favorably known as the manufacturers of hoisting machinery of a variety of forms and styles adapted to every requirement which hoisting machinery is capable of meeting. The great diversity of the service which machines of this class are called upon to perform, is the explanation of the variety of form and construction exhibited by the machines illustrated in catalogue of the firm which is now before us; but in all of them, it is obvious from an inspection, that the qualities sought to be realized are solidity of construction, compactness and efficiency.

The utility of machines of this class is so pronounced, that they are practically indispensable in all situations where it is necessary to move bulky and weighty articles and commodities in quantity from one level to another, as, for example, the removal of goods to and from the holds of ships, or from the streets to the various stories of lofty buildings, in pile driving, raising coal from wharves to depots and from depots to locomotive tenders, loading and unloading freight cars and wagons; for raising ores and the like. For all these, and many more uses, the employment of hoisting machinery involves an enormous saving of manual labor and time.



BACON'S DOUBLE-CYLINDER "SPECIAL" HOISTING ENGINE.

The hoisting engine illustrated by the accompanying engraving, is one of the most recent patterns of these machines made by the above named firm, and is designated in their catalogue as the Double-Cylinder "Special" Hoisting Engine. It is operated in the same manner as the single-cylinder "Special" lately described in this journal, but being intended for heavier work, it is provided with two cylinders, thus making it well adapted, by reason of extra strength, for use on steam lighters, in coal yards, for ice companies, oyster packers, fish and oil factories, and the like.

For further details respecting this class of machinery, our readers who may be interested in the subject are referred to the manufacturers above named—Copeland & Bacon, No. 85 Liberty street, New York.

Chinese Method of Manufacturing Vermilion.

There are three vermilion works in Hong Kong, the method of manufacture being exactly the same in each. The largest works consumes about 6,000 bottles of mercury annually, and it was in this one that the following operations were witnessed.

First Step.—A large, very thin iron pan, containing a weighed quantity, about 14 pounds, of sulphur, is placed over a slow fire and two-thirds of a bottle of mercury added; as soon as the sulphur begins to melt, the mixture is vigorously stirred with an iron stirrrer until it assumes a black pulverulent appearance with some melted sulphur floating on the surface; it is then removed from the fire and the remainder of the bottle of mercury added, and the whole well stirred. A little water is now poured over the mass, which rapidly cools it; the pan is immediately emptied, when it is again ready for the next batch. The whole operation does not last more than ten minutes. The resulting black powder is not a definite sulphide, as uncombined mercury can be seen throughout the whole mass; besides, the quantity of sulphur used is much in excess of the amount required to form mercuric sulphide.

Second-Step.—The black powder obtained in the first step is placed in a semi-hemispherical iron pan, built in with brick, and having a fire-place beneath, covered over with broken pieces of porcelain. These are built up in a loose, porous manner, so as to fill another semi-hemispherical iron pan, which is then placed over the fixed one and securely luted with clay, a large stone being placed on the top of it to assist in keeping it in its place. The fire is then lighted and kept up for sixteen hours. The whole is then allowed to cool. When the top pan is removed the vermilion, together with the greater part of the broken porcelain, is attached to it in a coherent mass, which is easily separated into its component parts. The surfaces of the vermilion which were attached to the porcelain, have a brownish-red and polished appearance, the broken surfaces being somewhat brighter and crystalline.

Third Step.—The sublimed mass obtained in the second step is pounded in a mortar to a coarse powder, and then ground with water between two stones, somewhat after the manner of grinding corn. The resulting semi-fluid mass is transferred to large vats of water, and allowed to settle, the supernatant water removed, and the sediment dried at a gentle heat; when dry, it is again powdered, passed through a sieve and is then fit for the market.

Petroleum as Fuel.

The Russians are considerably ahead of us in the application of petroleum as fuel. They employ it successfully upon some of their railways for driving locomotives, using for this purpose the crude naphtha as it comes from the wells. Most of the steamers that ply the Caspian Sea use the liquid fuel, which is very much cheaper than coal. It is consumed with the injectors that we are familiar with in this country, and the combustion is regulated with the greatest ease. A number of advantages are claimed for the liquid fuel. The furnaces last longer on account of the absence of sulphur; there are no cinders, smoke or sparks; the work of the attendants is greatly simplified, and the heating effect of the fuel considerably surpasses that of wood or coal.

The Flannery Boiler Setting for the Prevention of Smoke.

Under this title, Mr. Chas. A. Ashburner read a paper at the last meeting of the American Institute of Mining Engineers, which we deem to possess so much of interest to our mechanical readers that we present the substance of the paper in our columns. For the use of the engravings we are indebted to the courtesy of the secretary, Dr. T. M. Drown.

In introducing his description, Mr. Ashburner refers to the innumerable appliances that have been proposed, and modifications of boiler furnaces that have been devised, for the prevention of the smoke nuisance. He then proceeds to explain that the Flannery boiler-setting contains probably no original device, but is rather a new combination of parts, which, in its practical working, effectually prevents smoke from being thrown off from the chimney, and utilizes the heat units contained in the products generally lost. The quantity of fuel required to produce a given result is in consequence reduced.

describe a boiler setting, which, by experience, has been found to be practical and economical, and which seems to accomplish all that the designer claims for it. It is impossible to state in precise terms the value of the increase of heat obtained. As a rule, practical results differ so widely from theoretical computations that they can best be made after the determination of empirical values. The most important results to be noted, where this furnace is at present being used, are: The total absence of smoke where a dirty and highly bituminous coal is being consumed, a total saving of about 33 per cent of the coal required in an ordinary boiler-setting with the use of the same boiler and engine, and a great saving in the labor required to keep the flues clean.

The front portion of the furnace may be constructed after any of the ordinary designs which are applicable to a plain cylinder, cylinder-flue, cylinder-tubular, or the other general forms of steam boilers in common use. The boiler which is illustrated by the accompanying drawings is an ordinary cylinder-tubular boiler, which is being erected at Beloit, Wis., for the Rock River Paper Company. The most important points to be noticed in this boiler, are, the gas flues at G, Fig. 1, where the temperature of the products is equalized; the secondary grate A, with incandescent coals through which the products are passed, and the air ducts C above this grate, where heated air is introduced, whereby combustion is completed in the chamber I. After combustion has taken place at the front grate N, the products resulting therefrom pass under the boiler and over the bridge wall M. At the rear end of what is called the combustion flue, and a short distance (about 1 foot) back of the end of the boiler, the gases and soot are deflected by a fire-brick wall downwards and caused to pass through 25 circular flues in the lower part (Figs. 4 and 5). These flues are 3 inches in diameter and 1 foot 3 inches long. In the furnace which has been working for some time at Akron, Ohio, there is but one large opening in this wall, but the substitution of a number of smaller flues is thought to be a decided improvement. The flues are cleaned when necessary from the ash door E; the ashes may be taken out from the door E, or, better, from the door H, which is placed for this purpose. In practice the flues do not become coated with soot.

After going through these flues, the products pass up through the water grate A, which is covered with incandescent coal. The fuel here may consist of wood or anthracite coal or, better still, coke. The grate is surrounded by a fire-brick wall perforated by holes B, which lead into an air duct opening at the doors B′, Fig. 2. This air duct is only used in kindling or when the fire on the secondary grate becomes dead. In cases where limestone water is only to be had, a tile grate is employed instead of a water grate (see Fig. 5). The latter is, however, adjustable and can be readily replaced when the pipes become coated with lime or burnt. Immediately above the surface of the incandescent fuel there is a second air duct C C′, which is similar to the first, and which admits of the constant influx of air. The air is heated before entering the furnace by a free circulation around the wall confining the incandescent coals. The charging door for this grate is at F; I is the combustion chamber, from where the ultimate products pass through the boiler flues and are carried off by the chimney located at the front end of the boiler.

The principles involved in the working of this furnace are familiar ones. When atmospheric air enters the incandescent coal on the front grate its oxygen unites with the carbon of the coal and forms carbonic oxide. The excess of air becomes heated, and, if the temperature is sufficiently high, a union of the carbonic oxide with the oxygen of the air takes place and carbonic acid results. This is the case only in perfect combustion. In experience it is found that the gases above the grate and in the combustion flue beyond the bridge wall are carbonic oxide and air which have not united, in addition to the carbonic acid. The products of combustion which come from the front grate and enter the restoring flues G, are, therefore, a mixture of carbonic acid, carbonic oxide, air, soot and steam.*

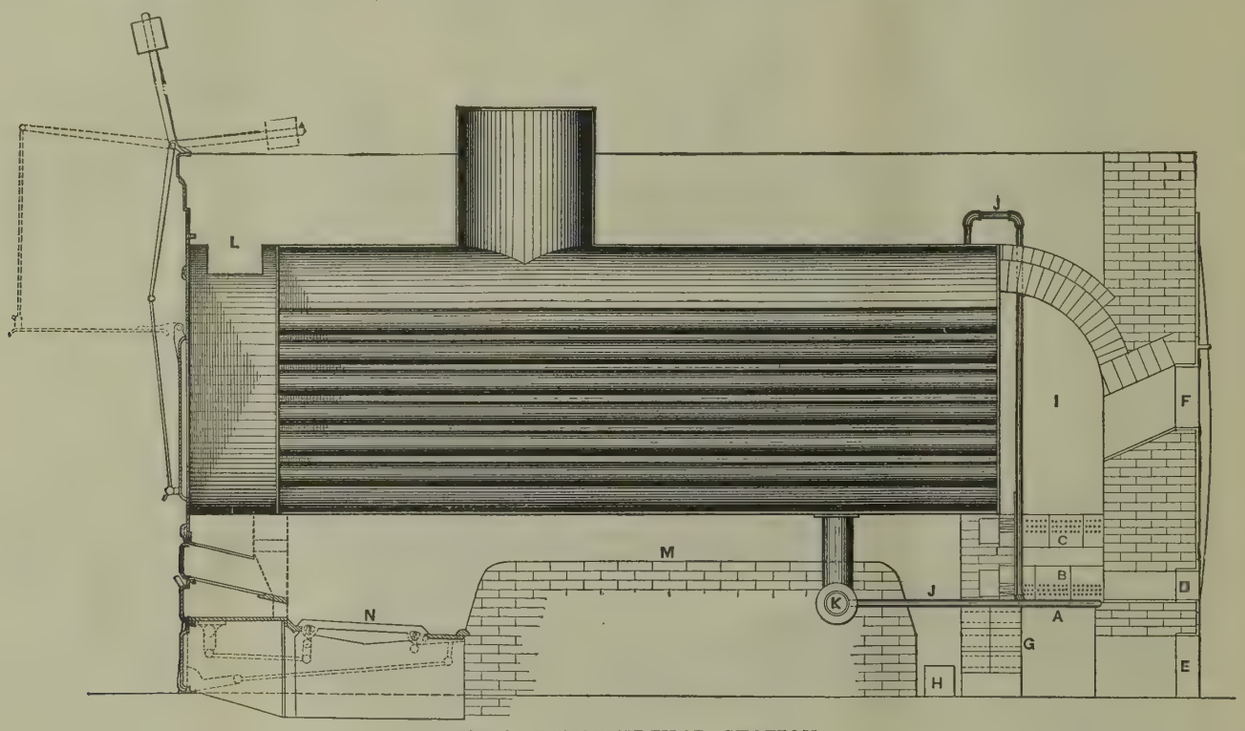


Fig. 1.—LONGITUDINAL SECTION.

In his explanation of the character of combustion, and of the products of combustion in the ordinary furnace grate, Mr. Ashburner states that the products of bituminous coal on a furnace fire-grate are generally considered to be steam, carbonic acid, carbonic oxide and soot. Of these, the first two are incombustible, and the last two combustible. To these four products may be added the nitrogen of the air. In cases, even where the draft of air through the grate bars is not excessive, there is a certain amount of unconsumed oxygen which passes through the boiler flues with the products of combustion. Absolutely perfect combustion of bituminous coal, says Mr. Ashburner, whose description we shall now follow, produces only steam and carbonic acid. The more nearly a furnace approaches this result, the more efficient is it in economizing fuel and in the prevention of smoke, or, more strictly speaking, soot, which is the solid carbon contained in smoke.

The economy of combustion in the Flannery furnace lies in the fact that the soot and carbonic oxide (which pass off through the chimney of an ordinary furnace) are almost entirely converted into carbonic acid before leaving the boiler flues. It is not my purpose to claim for this furnace the greatest economy of construction or duty, or even to make comparisons with other furnaces or boiler-settings which have been devised to accomplish the same end, but merely to

In substituting a number of flues for one large one, a greater surface is gained and the gases are more homogeneously heated. Of course these flues cannot give out any more heat than they absorb from the heated products as they come from the first grate. As the heat of these products is variable, due to firing and other causes, the heat of the flues will be an average of the heat of the products, and the gases as they enter the ash pit of the second grate will have a more uniform heat than before entering the flues. When these products enter the incandescent coal on the second grate the carbonic acid unites with a portion of the carbon of the fuel and forms carbonic oxide. This is a direct loss of heat units.† The heat,

* Nitrogen is not considered, as it does not directly affect combustion.

however, is regained by the carbonic oxide thus formed uniting with the oxygen of the air introduced through the ducts C, C′, and carbonic acid results. The carbonic oxide which comes from the front grate is raised above the point of ignition by the incandescent fuel and unites with the oxygen of the introduced air and forms carbonic acid. The excess of air enters the coals on the second grate and undergoes the same conversion as that which took place with the air entering the first grate. The particles of carbon,

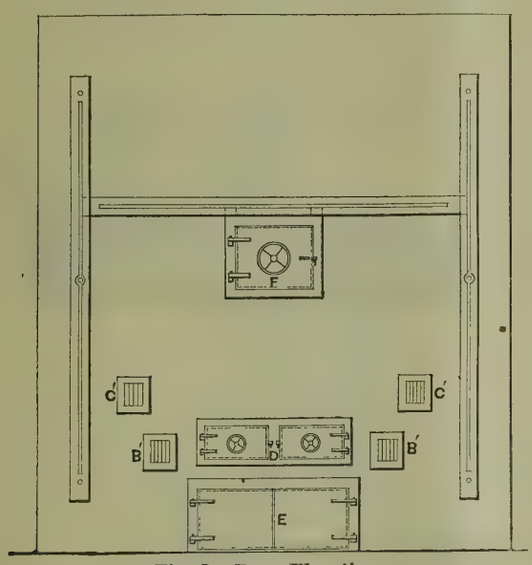


Fig. 2.—Rear Elevation.

forming the soot from the first grate, are raised to incandescence and, uniting with the air from the ducts C′, C′, form carbonic acid.

The steam is decomposed in passing through the coals on the second grate, the oxygen uniting with the carbon forming carbonic oxide, which is afterwards converted into carbonic acid above the surface of the coals. The liberated hydrogen unites with the oxygen of the air introduced through the ducts C, C′,

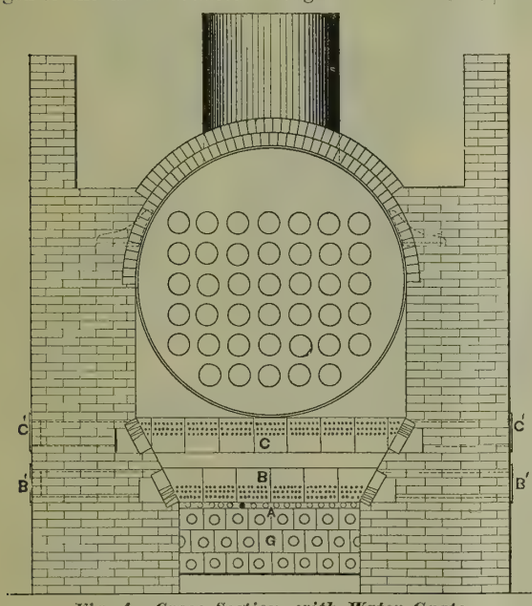


Fig. 4.—Cross Section, with Water Grate.

and again forms water. The ultimate products resulting from combustion in the Flannery furnace are thus carbonic acid, steam and a small amount of carbonic oxide,‡ but no soot.

The gases which go off in the chimney are of a higher temperature than in an ordinary furnace-setting, and this fact very materially assists the draught. At the Akron water works the chimney is erected at the rear of the boiler, and, although the gases are returned from the smoke-arch the entire length of the boiler, a sufficient draught has always been maintained.

A number of the Flannery furnace-settings have been constructed, and, after a trial extending over several months, have produced more than anticipated results in economizing fuel, in the consumption of soot and consequent prevention of smoke, and in a reduction in the labor, especially in that required to clean the flues.

At the Akron water works, recently constructed, two tubular boilers, 5 by 18 feet with 64 4-inch flues each, have been set on the Flannery system. Two Worthington pumps have been erected, one a compound high pressure, the other a compound condensing. Up to the present time the high-pressure pump and one boiler have alone been in service. The facts which have been noted in regard to the efficiency of the furnace have been very general, but they are such as to indicate its economy. The furnace has been fired, day and night, for eleven days, with 14 tons of a dirty, bituminous slack coal, which is mined in the vicinity of Akron, and sold at the works for $1 per ton. On the second grate Connellsville coke has been used, costing $6 per ton. For every ton of coal burned 300 pounds of coke have been used, the coke costing 90 cents per ton of coal consumed. The total cost of fuel for eleven days was $26.60.

The reservoir attached to the works is 210 feet above the pumps and 2,700 feet distant. The consumption of water has been about 1,000,000 gallons per diem. To do the same work the boiler with the usual setting would have required at least 35 tons of coal, at a cost of $35.

The average saving which would result in most cases from the use of the Flannery furnace would undoubtedly be greater than that shown at Akron, where the coal used is very poor and the cost exceptionally low. At Akron local conditions made it necessary to return the gases from the smoke arch to the rear of the boiler where the chimney is located, through a flue 40 inches square and 27 feet long. This is considered to be a disadvantage. I am informed by the superintendent of the works that the labor required to run this boiler is one-half of that which is ordinarily required with the usual setting.

The advantages which are claimed for this boiler-setting are: Economy of fuel and prevention of smoke, economy of labor, more even action of the boiler and its longer continuance in service, due to the small amount of deposits in the flues.

The system is particularly applicable in the setting of boilers where continuous service is required, where the cost of the fuel is great, where the space occupied by fuel is valuable, or where the production of smoke is objectionable.

† One pound of carbon in burning to carbonic acid gives out 14,500 heat units, one unit being the amount of heat required to raise one pound of water from 39° to 40° Fah. The same amount of carbon in burning to carbonic oxide gives out 4,400 units.

‡ If the furnace is properly fired and the draft properly regulated, all the carbonic oxide should be converted into carbonic acid in the combustion chamber I.

Soda in Wyoming.—The Philadelphia *Mining Journal* says: "Soda, which is now imported at a cost of from $52 to $55, can be taken from the soda lakes of Wyoming and placed in the Eastern market at a cost not exceeding $25 per ton. The Wyoming soda is chemically purer than the imported, and the method and rate of supply indicate practical inexhaustibility. Means are now being taken to secure early access to these deposits, and when these are perfected our import totals will lose an annual item of from $6,000,000 to $7,000,000." In Nevada crystallized soda can be dug up as ice is from a pond. Near Ragtown there is an inexhaustible supply of

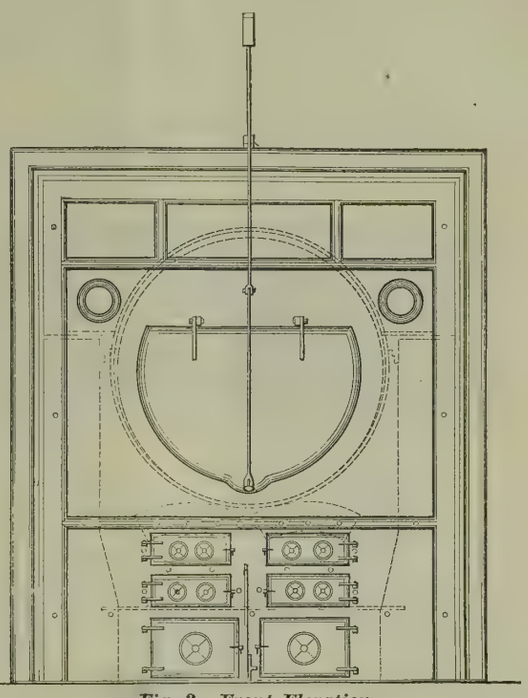


Fig. 3.—Front Elevation.

pure soda extending down to an unknown depth. On the surface of the ground are two or three feet of sand, but below this lies the soda, looking like a solid mass of ice. It was this soda that gave rise in early days—when the emigrants were crossing the plains—to the stories that in places on the plains there was to be found, under a few inches of sand, a solid mass of ice. The soda as dug up from the plains in sheets from 2 to 3 inches in thickness, really does look more like ice than does any other mineral formation.

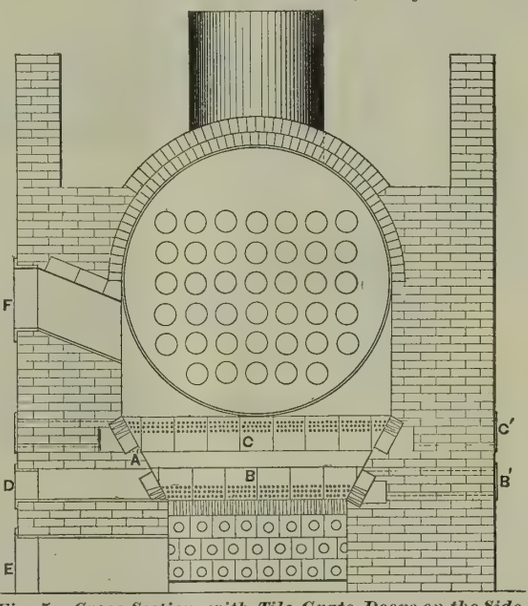


Fig. 5.—Cross Section, with Tile Grate Doors on the Side.

Salicylic Acid as a Disinfectant for cattle cars is said to be far preferable to carbolic acid, as it is quite as energetic, and leaves no unpleasant smell behind. It is employed largely abroad by veterinary surgeons as a curative agent for many diseases to which animals are subject, and is found useful in checking the spread of contagion among them. Its most important use, however, is for the preservation of food. During the prevalence of hot weather, meat, fish, etc., can be preserved by its use for several days.

Microscopic Accessories.

We illustrate and describe in the following an ingenious series of microscopic accessories devised by Mr. D. S. Holman, Actuary of the Franklin Institute, and a well-known microscopist. They are especially designed to facilitate the study of living organisms, for which purpose they are admittedly superior to all other devices of the kind, and in some branches of biological study they have become quite indispensable. Unqualified testimony to their value is borne by Prof. Joseph Leidy in his great work on the Rhizopods; by Mr. Ryder, the eminent specialist of the United States Fisheries Commission, and others less widely known. We are satisfied that every working microscopist who is not already familiar with them, will find the following description of these practical and ingenious devices interesting and instructive.

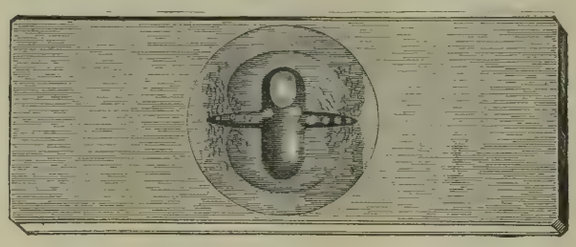


Fig. 1.

Fig. 1 illustrates a form of cell termed the life-slide, and is intended for use in studying the various forms of microscopic organisms. It consists of a deep central oval-shaped cavity, ground into the glass and polished, surrounding which is a shallow, circular-shaped bevel, sloping gradually upward to the surface of the glass slide. Extending from the sides of the deep oval cavity are two deep lateral grooves extending partially into the beveled depression surrounding it. The cell described is filled with the liquid containing the living creatures to be examined, and is covered with a thin cover-glass large enough to extend beyond the beveled circle. The advantages of this simple arrangement are as follows: The living

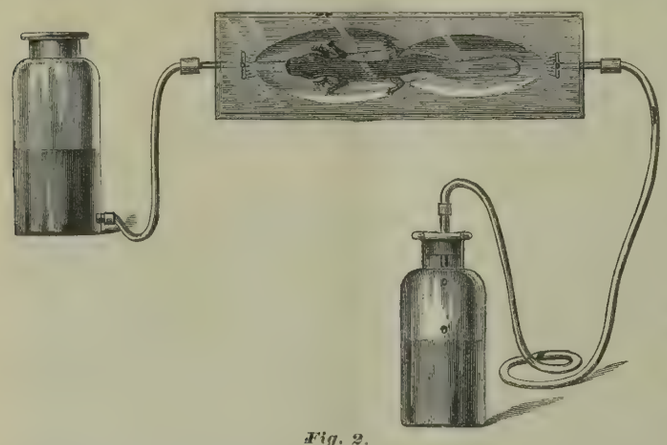


Fig. 2.

organisms, it is found, will always seek the edge of the pool in which they are confined, and the beveled edge permits the observer to take advantage of this fact, for there they come within the range of the high power glasses.

The object of the lateral grooves above mentioned, is to supply air to the living things in the slide and to equalize the pressure, which, owing to the evaporation of the liquid from the edges of the cover-glass, would soon become so great as to break it. As it is, the cover-glass becomes gradually concave on its upper surface as evaporation proceeds, and its edges are correspondingly raised, until communication is established with the atmosphere by the exposure of the extremity of the lateral grooves, when a bubble of air is forced to enter the slide through the groove, and equilibrium is thus from time to time re-established. By the artifice of supplying fresh air automatically in this manner, living things can be kept under the slide for days and weeks together without losing their vitality.

Fig. 2 represents a modification of the life-slide just described, and is appropriately called the "siphon slide." The central depression in this case may be of varying size and shape, according to the class of objects it is desired to study. In the engraving here shown it has a generally elliptical outline, and is several inches in length, to accommodate an animal of some size.

The extremities of the oval depression communicate with small openings drilled through the edges of the glass, and which serve for the introduction of metallic tubes, by which connections are made, by means of rubber tubing, with the siphon portion of the device. This consists substantially of a glass reservoir containing water, with an outlet orifice at the bottom communicating with the slide, while another acts as a receiver, The position of the slide, when in use, must be slightly above the level of the reservoir, while the orifice of the escape pipe must be below it, thus insuring a veritable siphon action in the device, a constant flow of water being secured through the slide. The cover-glass is retained in place by adhesion. In this simple apparatus living aquatic animals may be retained in the chamber for hours, or even days, without exhibiting any signs of uneasiness or suffering.

The utility of the device will be very obvious to teachers and students in histological studies. With its aid, a constant current of cold or warm water—the rapidity of flow being under complete control—may be caused to flow across the stage of the microscope without interruption for hours or days together, thus giving a convenient means of studying the circulation of the blood, with its attendant phenomena, in many animals, without the slightest exhaustion of respiration, and without the administration of narcotics, which give rise to pathological conditions unfavorable for such observations. Dr. J. G. Hunt, a histologist of repute, in speaking of the siphon slide, says that the migration of white-blood corpuscles in tissues not mutilated, the phenomena of inflammation, the delicate nerve fibers in living tissues, living epithelium, and many types of aquatic respiration (fresh water and marine), are all brought within easy observation of teacher and student. Its serviceability as a means of lecture illustration is shown by the feat which Mr. Holman has repeatedly accomplished—namely, of exposing the larva of the salamander for nearly an hour in the lantern microscope to the full influence of the oxyhydrogen light, and showing the circulation of the blood in the delicate branchia of the animal to a large audience, without any apparent injury to the subject. Many other equally interesting demonstrations can be made with its aid, which will readily suggest themselves to the operator.

Another microscope slide devised by the same inventor, is the "current cell," which is an outgrowth of the life slide, but designed for a different use. It is intended to afford the microscopist the opportunity of observing and studying the constitution of the blood and other organic fluids with greater precision and accuracy than is possible with other devices for the purpose. The current cell is shown in Fig. 3, and is constructed as follows: A piece of thick plate glass of the usual dimensions for a microscope slide is provided at equal distances from its center, with two well polished shallow cavities of circular form, which are connected with each other by two capillary channels. These channels are likewise polished, and to permit of a greater range in focussing for their contents, the channels are made of triangular section, with one side forming a right angle with the surface of the slide, and the other a very obtuse angle.

In order that the current passing from one cell to the other shall be highly sensitive, the slide should first be brought nearly to the temperature of the body

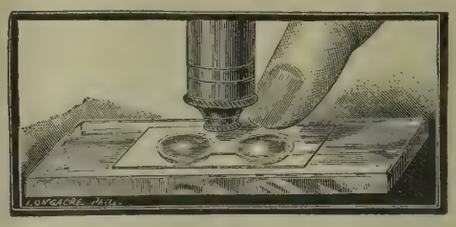


Fig. 3.

by holding it for a few minutes in the hand. A small quantity of the liquid to be examined (blood, for example), should then be placed in each cell and a thin cover-glass placed upon them. If this is held down for a moment, the warmth of the touch will slightly rarify the air in the cavities, and the cover-glass will be firmly held in place, partly by adhesion and partly by the slight difference in atmospheric pressure. The center of the cavities should now be found to be occupied by a bubble of air, while a thin annulus about their circumferences, as well as the connecting capillary tubes, are occupied by the liquid.

If the slide is now placed on the stand of the microscope, and the instrument focussed upon the contents of one of the connecting channels, a number of blood corpuscles, red and white, will be observed, but all at rest. If the finger is now approached to the neighborhood of the cell, a current, more or less rapid, according to its proximity, begins to flow beneath the object glass. When the finger is removed, the direction of the current is reversed.

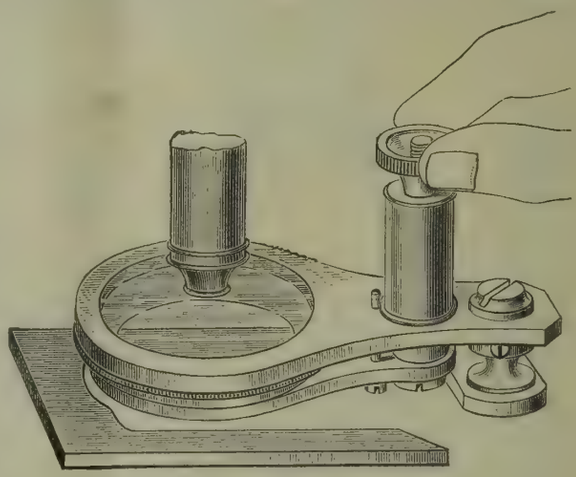


Fig. 4.

The current is caused by the expansion of the air bubble nearest the finger, by the heat radiated from it, and the rapidity of the circulation may be controlled with great nicety by removing or approaching the finger. No foreign substance need be added to the material under examination; and so sensitive is the device, that even with the highest powers, a corpuscle, granule, etc., in the field of view, may be leisurely turned over and over in any desired position, thus affording the microscopist an unequaled means of observation and study.

Moreover, if each cell be entirely filled, but with

liquids of different densities, the cell holding the denser liquid being placed slightly higher on the rotating stage of the microscope than the other, the action of gravity will cause the two liquids to change places, the currents flowing in opposite directions through the communicating channels. In this way many interesting phenomena, such as crystallization, etc., may be observed for a considerable length of time, which otherwise are only brought to view with difficulty.

To complete the list of Mr. Holman's useful contrivances for the microscope, we will refer finally to the compressor and modified siphon slide (the first named of which is shown in Fig. 4), and which were described in detail in this journal for September, 1880.

The compressor is arranged to operate differently from those commonly in use, in that the mica cover is fixed and immovable, while the compression is effected by raising the lower plate of glass, which is carried in a brass frame, and is moved up or down by the thumb screw seen in Fig. 4. This arrangement avoids the danger of breaking cover glasses, crushing the object, and injuring high-power lenses, while at the same time it gives any desired amount of compression.

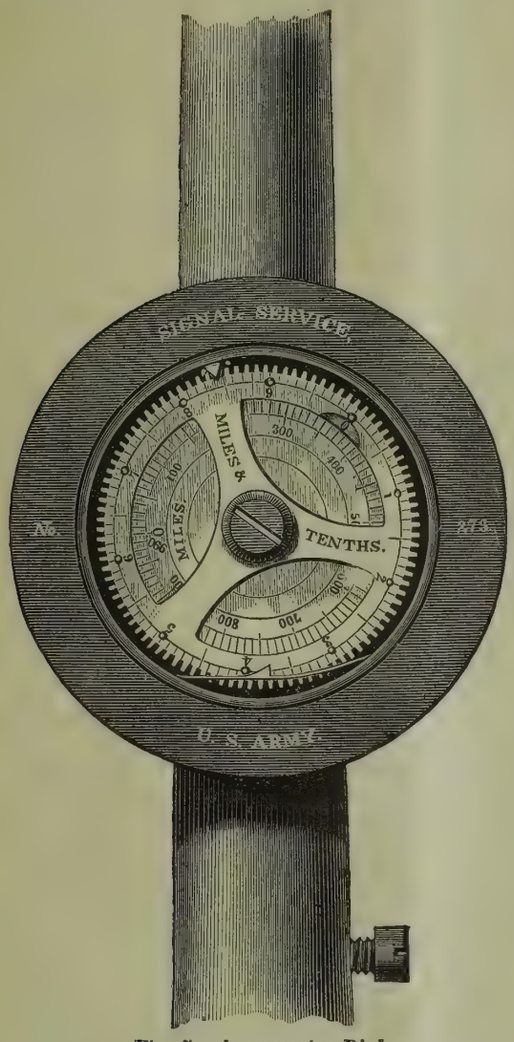


Fig. 5.—Anemometer Dial.

Mr. Holman has also devised a modification of this device, consisting of the usual animalcule cage, with the addition of the siphon attachment. The edge of the cover or cap is beveled, so that by rotating it against the inflow and outflow tubes of the siphon a convenient and effective compression is obtained. It is pronounced by experts, who have used it with success, to be a very useful arrangement, on account of the facility with which living plants (fungi and the like) and aquatic animals (larvæ, and the like) can be kept alive for a lengthened period for study or exhibition. It was in one of these moist chambers, as we noticed in a former issue, that Mr. Ryder succeeded in successfully hatching young shad, right under the microscope, a feat never before accomplished with the eggs of fishes.

We have thought that those of our readers who are familiar with the microscope, would be interested in a connected history and description of Mr. Holman's ingenious and practical devices, which have come to be regarded as an indispensable portion of the paraphernalia of the microscopist who is desirous of studying living organisms.

The Signal Service and its Methods.

[*Continued from page* 60, *March Number.*]

Exposed Thermometer—Method of Using and Caring for Instruments.—The reading of the exposed thermometer is directed to be made as follows: The instrument must be hung in the shelter so that it shall always be in the shade, and at least one foot from the wall of the building. It must be protected from the heat reflected from surrounding objects, and from rain, hail or snow. It must be hung vertically, with the middle of the scale about at the level of the eye of the observer. The readings must be made at all times, but especially in winter, through the panes of the glass, without raising the sash, where the shelter is built out from the window; or, where the shelter is on the roof, great care must be exercised to prevent the readings from being affected by the heat of the body. On this account the readings should be made as rapidly as is consistent with accuracy. Observers are required to test the accuracy of their thermometers every three months. For this purpose, they are directed to place the instruments to be tested in the vessel provided for this purpose, keep them in a vertical position, pack finely pounded ice around them to a hight a little above the freezing point, and let them remain for half an hour, at the expiration of which time read off the hight of the mercury without removing the thermometers from the ice, and note the result of the test of each thermometer, and report it to the central office. If corrections have been authorized for any thermometer, the fact, with amount of such correction, must be stated. In testing the maximum thermometer, it is necessary to tap the bottom of it on the bottom of the vessel in which it is tested, to bring the mercury down to the temperature of melting ice, care being taken not to break the instrument during the operation.

Maximum Thermometer.—The maximum and minimum thermometers are directed to be attached to the board which accompanies them and securely fastened with screws in a horizontal position upon the traverse bars which support the wet bulb and the exposed thermometers in the shelter. The maximum temperature is obtained by noting the number of degrees upon the scale at the top of the mercury column. After making an observation, the observer is directed to remove the pin supporting it, to take hold of the instrument about three inches from the top and to spin it around several times, or until the top of the column is brought down to the temperature of the air. It should then be replaced as before.

Minimum Thermometer.—After fastening the top of the instrument upon the support, the lower end is to be raised until the top of the small index touches the top of the column of spirit. The instrument is read by observing the number of degrees upon the scale where the top of the index rests. After taking a reading, the bulb or lower end of the thermometer should be elevated until the index touches the top of the column, when the instrument will be dropped into the notch at the left of the support, as before.

Water Thermometer.—The apparatus for noting the temperature of the water consists of a small thermometer enclosed in a cylindrical metallic case. A portion of the case is hinged so as to be swung open when it is desired to read the thermometer. A valve at the bottom of the case admits the water as it sinks to the bottom of the river or lake, and, falling into place when the case is drawn up, prevents the water from escaping.

The directions for using this instrument provide that one observation shall be made at 2 P.M. (Washington time) daily of the exposed thermometer and the temperature of the water at the surface and bottom of the lake, bay or river upon which the station is located. The observer is directed to select some convenient point on the shore (a wharf or pier, when practicable) where a sufficient depth of water exists to give a positive difference between the surface and bottom temperatures, and to provide himself with enough strong cord to reach the bottom at the place selected. One end of this cord must be securely fastened to the wire handle at the upper end of the cylinder enclosing the thermometer. In making the observations, the observer must first note the temperature of the air as shown by the exposed thermometer in the shelter; then that of the surface water by immersing the thermometer in the upper stratum of water, allowing it to remain long enough therein for the mercury to acquire the temperature of the water; and then, lowering the cylinder slowly to the bottom, must allow it to rest there long enough to fill, after which it must be quickly drawn to the surface, and the temperature shown by the thermometer carefully noted. The water must then be poured out of the cylinder after each observation, and the thermometer thoroughly dried.

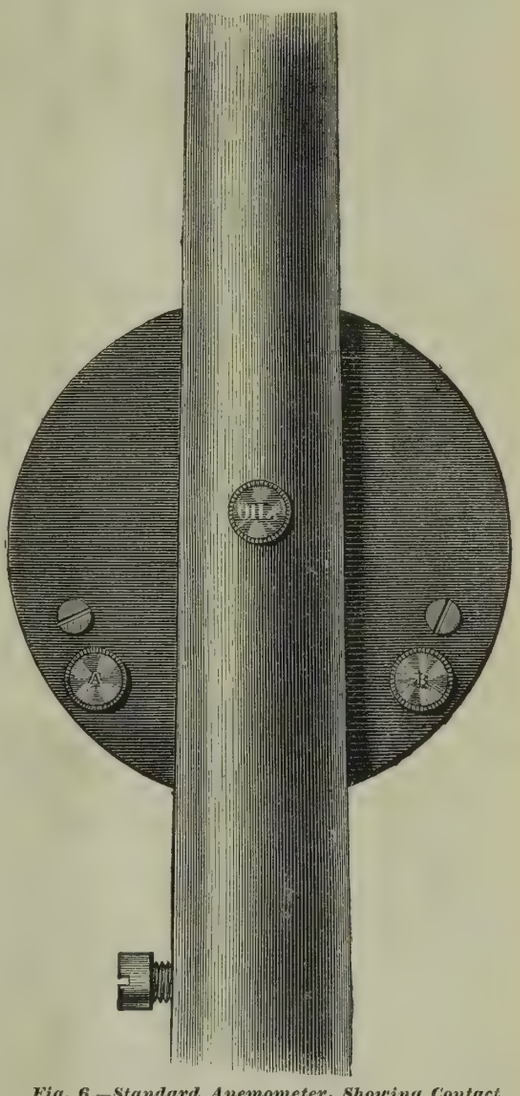


Fig. 6.—Standard Anemometer, Showing Contact Screws.

Wet-Bulb Thermometer.—The wet-bulb thermometer is directed to be placed in the same shelter as the

exposed thermometer. The cistern must be kept supplied with pure rain water at all times when the temperature of the air is above the freezing point, and the cover of the bulb must be changed every month and the bulb carefully cleaned. The cover may be washed as often as necessary, without removal, by a jet of water from a small syringe.

When the temperature is below the freezing point, the wicking must be removed and the water emptied from the cistern. In making an observation, the wet bulb is directed to be moistened with cold water, applied with a camel's hair brush, and the instant the mercury has reached its minimum its hight is to be noted. The relative humidity and dew-point are obtained from tables with which observers are provided. Observers are required to be careful to keep the wet bulb clean and properly moistened, and to make the observations and deductions properly, as the humidity of the air forms an important element in all calculations of atmospheric changes.

Anemometer.—The anemometer must be fixed in a vertical position upon the telescopic rod, the upper joints of which must be run up to its full extent, or when this rod has not been furnished, upon a post of sufficient hight to expose it to the full force of the wind. When possible, this post should be framed into the roof to steady it and prevent the instrument from vibrating; but when this cannot be done, it should be framed at the bottom into two pieces of scantling, not less than three feet in length, crossing each other at right angles, which can be nailed fast to the roof or platform upon which the instrument is placed. Short braces must be added, when necessary, to insure steadiness. The outer dial of the instrument is graduated in miles, and tenths of miles, the figures 1, 2, 3, etc., indicating miles, and the subdivisions tenths. One complete revolution of this dial is equivalent to ten miles of wind. This anemometer registers up to nine hundred and ninety miles.

Observers are required to assure themselves by making daily comparisons that the record of the dials and that of the self-register agree at the time of changing of the record sheets in the self-registering attachment at midday, and explicit and detailed directions are given to determine any such discrepancy, and for the proper care of the instrument:

Description and use of the Anemometer.—The outer dial has 100, and the inner dial 99 divisions, as the dials are moved by the same wheels, they will move forward 100 divisions in the same time, Fig. 5. The outer dial having 100 divisions, the inner dial will complete one revolution and its zero be one division beyond or to the left of the zero of the outer dial when the outer dial has completed one revolution, the zeros of the scales coinciding at the time the instrument was set in motion. Thus the revolutions made by the outer dial are recorded on the inner one, the number of revolutions being shown by the number of divisions of the scale on the inner dial between the zero of that scale and the zero of the outer one. In taking the reading of the anemometer at any time the hundreds and tens of miles are read from the inner scale, and the units and tenths of miles are read from the outer one. Take from the inner scale the hundreds and tens of miles contained between the zero of that scale and the zero of the outer one, and the units and tenths of miles on the outer scale contained between the zero of that scale and the index of the instrument, and the sum of these readings will be the reading of the instrument at the time of making the observation.

When the anemometer is not furnished with an index-point, the center of the small wheel which gives motion to the dials will be taken as the reference point.

To obtain the velocity of the wind for the regular observations when the self-registering attachment is out of order, two readings of the outer dials must be taken with an interval of five minutes between them, and the *difference* between these readings will be the distance in tenths of miles traveled by the wind in that interval. This multiplied by 12, will give the approximate velocity in miles per hour. Example: suppose the index of the anemometer to be at 3 on the outer dial when the first reading is taken, and at 3.6 five minutes after, the difference, .6, is the distance traveled in that time; and this, multiplied by 12, gives a velocity of seven and two-tenths miles per hour. Whole numbers only are to be used in expressing the velocity; when the decimal is *greater* than five-tenths, the unit's figure will be increased by one; when *five* or *less* it will be thrown out.

The maximum hourly velocity of the wind when the self-registering attachment is used is determined by multiplying the number of miles, recorded in the fifteen minutes in which the maximum occurred, by four, and when the dial-readings are used, by multiplying the highest velocity in a period of five minutes by 12. The total movement of the wind in the preceding 24 hours, as shown by the anemometer, must be noted by the observer daily at 12 noon, local time and recorded on the anemometer sheets. The total movement for the 24 hours is obtained in the following manner: Subtract the reading of the anemometer at 12 noon, of the preceding day, from the reading taken at 12 noon of the current day, and the difference will be the total movement of the wind. When the reading of the anemometer is less than the reading of the preceding day, 990 miles will be added to it and the remainder after substracting the reading of the preceding day, will be the total movement.

Example; the dial reading of to-day is 91, and that of yesterday was 950, hence we have 91+990=1081;—950=131, the total movement of the wind in miles during the past 24 hours. Observers must familiarize themselves with the construction of the several parts of the anemometer, in order that they may be able to locate faults whenever the instrument is out of order.

Electric Self-Recording Anemometer Attachment.—The following directions for setting up and the general management of the electric self-recording anemometer attachment, adopted by the central office, are required to be observed at all stations supplied with the apparatus. Near the top of the post or telescopic rod, on which the anemometer is fixed, the wires must be fastened separately, leaving just sufficient of the upper end of each wire to reach to the ouside ends of the contact screws A and B, Fig. 6, to which they must be securely fastened. Then the lower ends of the wires are passed down the post, over the roof and down the side of the house (secured by pieces of insulated wire so that the wind will not sway them), to the top of the office window; then they are passed in through two small holes (where the sash and shutters will not injure them), and down the inside. In crossing the roof, it is directed to fasten them between two wooden strips, one on top of the other. Particular care must be taken that all the connections are firmly made.

In adjusting the armature spring, care must be taken not to make it too strong for the magnet, and still strong enough to draw back the pencil in a straight line. The pencils must be kept pointed enough to give a clear, distinct mark. The clock must be wound every day, when the record is changed. The record must be changed daily at 12 M. (noon).

At stations furnished with this self-recording apparatus, the hourly velocity of the wind will be deduced from the record of the 15 minutes (multiplied by four) immediately preceding the time of observation. In case the cups are moving at the moment of observation, and the anemometer has not closed the circuit during said 15 minutes, but during the preceding hour, the whole number of miles will be taken from the whole hour preceding.

[*To be Continued.*]

A Remedy for the Smoke Nuisance.—It is affirmed that a committee from Cincinnati, where the city councils lately passed a stringent ordinance for the abatement of smoke, lately visited London, to study the devices on exhibition at South Kensington, and that they have returned without having seen any remedy adequate for the suppression of the evil.

The remedy is already found in gaseous fuel, if the sapient legislators and committeemen only had the sense to see and understand its advantages.

A Novel Method of Insulating Electric Light Wires has been devised by Mr. P. B. Delaney, of this city. It consists in stringing on the wire or wires a continuous line of porcelain buttons. These are large or small, according to the size of the wire, and are perforated with as many holes as there are wires to be accommodated.

The porcelain buttons keep the wires always at the same distance apart, and while they do not interfere with the flexibility of the line, permitting it to be bent at any desired angle, form an insulation that is practically indestructible, not liable to injury by the heating of the wires, or to deterioration from causes which would seriously impair the permanency of gutta-percha.

Where the wires are carried into the interior of buildings, no further protection than the porcelain buttons is needed. Where the line is carried underground or overhead on posts, an exterior wrapping of paraffined tape is necessary to exclude moisture. The Delaney insulation, in addition to the merits above named, has also the additional advantage of cheapness. The invention is a recent one and has already attracted much attention from the electric lighting companies. We append a statement of the inventor's claims. They are as follows:

For this method of insulation the inventor claims indestructibility by the heating of the conducting wires, or from gases, frost or any other cause. There can be no change or deterioration in the insulating properties of the porcelain, so that when once introduced there is an absolute guarantee of permanency, no repairs or renewals being necessary. All other insulation must fail sooner or later, and no matter what the compound may be, it will from the beginning be subject to decay or disintegration from some or all of the causes named.

All danger of fire is obviated. The conducting wires may be burnt by intense currents, if you choose, but the insulation remains unaffected, as the porcelain disks, when manufactured, are subjected to an intense heat. When enclosed in a metallic pipe, it would be impossible to burn up the most inflammable substance by the heating of the wires. The wires are at all times equidistant and perfectly insulated from the pipe or other surrounding object, and any twist, bend or angle necessary can be made with the greatest facility, owing to the flexibility of the cable. It can also be laid down in any length desired without splicing, can be rolled on a reel and shipped to the point required ready for drawing into the pipe.

When laid under the ground, in order to prevent condensation of moisture on the insulating disks, an insulating compound of asphalt or other well-known compounds, are forced in hot; so as to fill up the vacant space in the pipe; then the cable is in working order as long as the pipe will last. No matter what takes place to the compound forced in, the wires are maintained in the same position. When used in buildings, no other insulation than the porcelain buttons is necessary, as there would be no moisture in the air in the pipe.

Since the permanency of the insulation is insured, there is no reason why wires should not be introduced into buildings when erected, through pipes, in the same manner as gas and water pipes are now introduced.

ELECTRICITY AS A MOTIVE POWER.—Prof. Preece, the noted English electrician, in a late lecture on the applications of electricity, printed in the *Popular Science Monthly*, made the following remarks respecting its applicability as a motive power:

"If, by the exertion of mechanical power, currents of electricity can be produced, those very same currents of electricity can in their turn produce mechanical power. It, instead of receiving currents of electricity from the dynamo-machine on the Thames embarkment, we transmitted currents of electricity to it, we should cause it to rotate, but in the reverse direction. I have here a small machine for the purpose of illustrating this to you; it is the invention of Mr. Griscom, who has supplied it to a large extent in America for turning sewing-machines. The wires from the hand dynamo-machine are now attached to the Griscom motor, and, when currents of electricity are generated by turning the handle of the dynamo, they are conveyed to the motor, and cause it to revolve with the high rapidity you see It is surprising that such a tremendous momentum should be produced by so small a strength of electric current. The wires connecting the two machines in this instance are short but the effect would have been practically the same had the machines been miles apart. By changing the wires, the direction in which the motor rotates is reversed so that I not only get power transmitted, but can reverse its direction. In this case, as the electricity is generated by hand, its power is small; and, therefore, with my strength (which is only about one twelfth of a horse-power), I can stop the rotation of the motor; but, if steam-power were employed to generate the electricity, the power transmitted would be beyond my control in that sense. This motive-power was illustrated, in many different forms, at the Paris Exhibition; for instance, from the commencement of the Champs-Elysees to the exhibition building, a tram-car was propelled (sometimes at the rate of twenty-five miles an hour) upon rails laid down for the purpose, and during the time that the exhibition was open, that car carried 75,000 to 80,000 people, who were conveyed to or from the building by motive-power generated by steam in the exhibition and conveyed by wires to the farther extremity of the track. An electric railway will form part of the Electric Exhibition at the Crystal Palace, and among the proposals to be laid before Parliament next session is a project for constructing an electric railway between Northumberland avenue and Waterloo station. Again, at the Paris Exhibition, an enterprising firm of agriculturists showed land-plowing by electricity, and, in fact, the application of electricity to innumerable useful purposes was illustrated—rock-boring, newspaper-printing, driving of sewing-machines, embroidery, leather-work, glass-cutting, wood-carving, hoisting, ventilation, etc."

NEW OBSERVATIONS IN TANNING.—Sadlon, a German chemist, referring to the imperfections of the present methods of tanning, calls attention to the fact that the greatest defect resides in the fact, that, as the operation is universally conducted, only about two-thirds, and often only one-third, of the real tannin substance is utilized, while the remainder is wasted.

The first condition necessary for effecting a rational extraction of the total tannin contained in the material used, is the employment of an elevated temperature. Thus the cells of the material used are softened more quickly and perfectly, the diffusion is accelerated, and the solvent power of the water increased so that concentrated solutions are obtained, and larger proportions of the insoluble modification of the tannin dissolved. The only objection raised against hot extraction, is that the color of the leather tanned with such extracts is always darker. This objection, however, can be overcome by cooling the extract before the skins are introduced.

Sadlon found that on cooling to 65° Fah., large quantities of a yellowish-brown precipitate were deposited, consisting chiefly of the insoluble modification of tanning. He found, also, that this behavior was not peculiar to oak bark, but that the same precipitate was obtained with other tannins. He made, thereupon, a series of experiments with the view of obtaining a good solvent for this precipitate, and finally decided that sodium borate gave the best results. By treating the tannin material with warm water containing 0.5 per cent of borax, he obtained a very strong extract, which, on cooling, no longer deposited any precipitate. He found, moreover, that this method considerably increased the durability of the extract, and greatly reduced the time required for tanning skins. Fresh skins treated with this extract showed no evidence of shrinkage. The external and internal layers maintained their natural character, the skins remained soft, and the pores remained open.

These observations are important, and suggest a line of investigation which may lead to important improvements in the art of tanning, wherein there is great room for the intelligent labors of technical chemists.

REMOVAL OF INCRUSTATIONS FROM WATER PIPES.—At the last meeting of the American Society of Civil Engineers, a paper by Mr. E. H. Keating, City Engineer of Halifax, was read by the Secretary. The paper described the results of the mechanical removal of incrustations from the water pipes of that city.

These incrustations had become so serious as to reduce the pressure, so that in many places water would not flow from the street hydrants. In some of the pipes the deposit was over 1¼ inches in thickness. Six-inch pipes were found reduced to an internal diameter of 3¼ to 3½ inches. In the years 1875 and 1876 a number of miles of old 3-inch pipes were cleaned by a scraper attached to iron rods and propelled by hand. The scraper had four arms or knives attached to a center and sprung outward by a thick rubber disk. This method was not practically applicable to pipes of large diameter; but in 1880 over a mile of 12 inch pipe was cleaned by a scraper forced through the whole length by the head of water in the pipe. This scraper was one imported from Scotland, and its work was fairly successful.

In 1881 the author of the paper constructed new scraping machines which differed from the others in having additional springs for the cutters and the pistons. These scrapers consist of an iron rod, to which are attached two pistons and two sets of cutting tools, one in front of the other. The cutters are each made up of four strips of steel 2½ inches broad, sloping backwards from the rods, and at their outward terminations shaped and sharpened like the barbs of an arrow. Thus they can yield when requisite, and the cutting diameter can be altered by moving the steel strips. The pistons are of iron, lead and leather, to which Mr. Keating adds rubber springs. With this apparatus, and with the ordinary head in the pipes, about 12 miles of 24, 20, 15 and 12 inch pipes were cleaned at a total cost of $2^{8}/_{10}$ cents per foot. The results were remarkably satisfactory, as is shown by the fact that the average pressure on 25 hydrants on the wharves increased from $34^{3}/_{10}$ pounds in February, 1880, to $52^{4}/_{10}$ pounds in February, 1882. These were on the low service, the source of which is four miles from the city and 200 feet above tide. On the high service, the source being 8 miles from the city and 360 feet above tide, there is now a pressure of 19 pounds per inch at hydrants where the water did not flow at all.

RELATIVE NON-CONDUCTIVITY.—Mr. Charles E. Emery, of this city, recently made some experiments upon relative non-conductivity, with reference to the needs of the New York Steam Company. His apparatus consisted of a boiler 12 feet long and 4 feet in diameter, with three 10-inch flues passing through it. Inside these flues were smaller tubes, through which the steam passed. The non-conductors surrounded the inner tubes, and water was kept circulating around the flues in the outer shell. A layer of hair felt 2 inches thick gave the best result, and, using equal thicknesses of the other materials, the following results were obtained:

Material.	Non-conductivity. Per cent.
Hair felt	100
Mineral wool, No. 2	83.2
Mineral wool, No. 2 and tar	71.5
Sawdust	68
Mineral wool, No. 1	67.6
Charcoal	63.2
Pine wood, across grain	55.3
Loam	55
Gas-works' lime, slaked	48
Asbestos	36.3
Coal ashes	34.5
Fuel coke	27.7
Air space, 2 inches deep	13.6

The low result from air space no doubt is due to unimpeded circulation of the currents.

WARMING RAILWAY CARS, ETC., WITH SODIUM ACETATE.—The use of crystallized sodium acetate for heating railway and other carriages, was mentioned in a former number of this journal. The *rationale* of its use is described as follows by M. Angelin in a communication to the French Academy:

He remarks that water, on account of its great specific heat, has been almost exclusively used for purposes in which a storage of heat is required. Crystallized sodium acetate contains, however, four times as much useful heat per volume as water. Thus, for instance, a warmer of 11 liters capacity, containing 15 kilograms of the salt, would liberate 1,731 cals. on cooling from 80° to 40° C., while the same warmer filled with water, on cooling between the same limits of temperature, would liberate only 440 cals.

Further, the necessary temperature is maintained for nearly ten hours, while if water is used the warmers must be charged every 2½ hours. The warmers can be filled once for all, with certain precautions to avoid superfusion; the stoppers must be well soldered, and the whole apparatus made perfectly air-tight, to avoid loss. As the salt is perfectly stable, it can be used indefinitely.

Experiments with the view of introducing this salt have been made on various railways on the continent, and in England on the London & Northwestern railway. As is well known, the small compartment coaches in use abroad, are very different from the long cars, with a passage the whole length, in use on American railways; and the methods in use in Europe for warming such conveyances would not be applicable here without material modifications. Nevertheless, though they could not probably be introduced here, the methods in use abroad are worth noting, as it is becoming more and more evident that we must change our present methods.

MINERALOGICAL BREVITIES.—Mr. E. Divers describes in the *Chemical News* a natural *sodium alum*, occurring as an efflorescence on decomposing sodium feldspar, in the province of Idzumo, Japan. The alum is of the normal type, crystallizing with 24 H_2O.

Bloomstrand describes under the name of *arctolite*, a mineral from Spitzbergen occurring in the form of bent plates, of about one-third of an inch thick, in crystalline limestone. It is colorless, to light green, and has the general formula of phrenite.

Graterola describes a new variety of beryl from Elba, showing peculiar optical qualities. He terms it *rosterite*. It is characterized also by its small percentage of glucina, as compared with common beryls.

Girardin has made an interesting observation on the artificial production of *vivianite*. Spent bone-black (that which has been used for decolorizing sugar solutions), when ignited, leaves a semi-fused mass of a color varying from that of verdigris to that of ultramarine, due to the formation of vivianite. The iron, which is not originally in the bone-black, is introduced during the manufacture, by the action of the more or less acid beet-root juice on the iron of the containing vessel.

Silk Culture.

To the Editor of the Manufacturer and Builder:

We respectfully ask the coöperation of the press in our efforts to bring before the public the advantages of home cultivation of the silk-worm, so that the silk-looms of our own country can be supplied with raw material raised here, and the many millions of dollars, that now annually go to foreign countries for raw silk, may be kept at home. In no way can this object be accomplished as quickly as by giving publicity to the importance of the industry, and by showing how well it is adapted to our own people and climate. We herewith inclose a report of our silk fair, just closed, and ask you to print it in your columns. Will you kindly mail us a marked copy of the issue containing it.

H. Annie Lucas, *Cor. Sec.*
Women's Silk Culture Association, 1328 *Chestnut St., Phila.*

The award of the premiums offered, through the Women's Silk Culture Association, for the four best specimen pounds of cocoons raised in the States of Pennsylvania, Delaware, Maryland, and New Jersey, was made at St. George's Hall on February 8th. The same offer is renewed for the coming year, and can be competed for by any of the readers of the Manufacturer and Builder in the States mentioned, who will raise one pound of cocoons and send it to the association. Instructions for raising silk-worms, and the rules govering the competition for the premiums, can be had free of charge by addressing the Women's Silk Culture Association, Philadelphia.

The fair of the Women's Silk Culture Association, at St. George's Hall, has proved to be a success in every particular. The public interest in the remarkable display was very great, and competent judges pronounce it the finest thing of the kind ever seen in this country. The great interest in the display consisted in the fact that nearly all the beautiful articles on exhibition were the products of American skill and industry, and rare silk fabrics were shown made in Philadelphia, even at St. George's Hall during the exhibition, that fully rivalled any of Oriental origin. The attendance was large on the occasion for awarding the premiums offered by Messrs. Strawbridge & Clothier. An address was made by Rev. James Neill upon the objects and purposes of the Women's Silk Culture Association. Mrs. Lucas then explained the manner of testing the value of the specimens of cocoons in competition.

There were twenty-six contestants for the premiums, which were awarded as follows: First premium, $200, to Mrs. Rebecca Taylor, Kennett Square, Chester County, Pa., for best specimen pound of cocoons, which averaged 157 to the quarter pound, and yielded 1⅛ ounces of silk, and 2⅞ ounces waste. Mrs. Taylor is the mother of the late Bayard Taylor, the poet and statesman, and is, over eighty-two years of age. It was stated that she is a sufferer from paralysis, or she would have exhibited her interest in the work of the association by her presence. Second premium, $150, to Mrs. H. M. Button, Camden, N. J., her cocoons averaging 198 to the quarter pound, and yielding $1^{7}/_{32}$ ounces silk, and $2\ ^{25}/_{32}$ ounces waste. Third premium, $100, to Charles Krauss, Egg Harbor City, N. J., for cocoons averaging 157 to the quarter pound, and yielding $1^{1}/_{16}$ of silk and $2^{15}/_{16}$ ounces waste. Fourth premium, $50, to Miss Lillie Titus, Camden, N. J., for cocoons averaging 205 to the quarter pound, and yielding 1⅛ ounces silk and 2⅞ ounces waste. The association also awarded a fifth premium, $25, to Mrs. Joseph Lennig, Bridesburg, Pa., for cocoons averaging 225 to the quarter pound, and yielding $1\ ^{3}/_{16}$ ounces silk, and $2\ ^{13}/_{16}$ ounces waste. Sixth premium, $15, to Miss Hannah Taylor, Cambridge, Burlington County, N. J., for cocoons weighing 166 to the quarter pound, and yielding 1 ounce silk, and 3 ounces waste. Seventh premium, $10, to Mrs. J. B. Kemmerer, Bethlehem, Pa., for 200 cocoons, yielding 1⅛ ounces silk, and 2⅞ ounces waste.

Wine Production of the United States.—From the statistics gathered by the Department of Agriculture, it appears that 181,583 acres of land in the United States are devoted to the culture of the grape, affording a production of 23,453,827 gallons of wine, having an estimated value of $13,426,174. California takes the lead in the production of this article.

The Lambie Adjustable Book-Holder.

The accompanying cuts represent various views of an adjustable book-holder, designed by the inventor

Fig. 1.

to add to the comfort and convenience of literary and professional men. It is a labor-saving device that will not fail to receive due appreciation from the classes for which it is designed.

Fig. 2.

The cuts describe the holder so well that an extended description is quite unnecessary. Fig. 1

Fig. 3.

shows the holder supporting the largest sized unabridged dictionary open; Fig. 2 shows the stand supporting the same book closed; Fig. 3 represents the holder supplied with a convenient shelf for holding other works of reference; and Fig. 4 shows the device folded up in compact form for shipping.

Fig. 4.

The special advantages of this device may be stated briefly as follows: It can be adjusted to fit any size of book. The standard may be raised or lowered to bring the stand to any desired hight. The holder proper can be adjusted to hold the book at any desired angle, so that one may read upright or reclining. The stem can be held rigid or left free to rotate by clamping or loosening a binding screw. It will hold the book firmly open or closed, and without injuring the most costly binding. The stand can be used either as a book-holder or as a writing-stand at pleasure. It is sufficiently rigid to hold the largest sized book without becoming unsteady from its weight. It is so constructed that when it is desired to place it aside, or to transport it, it may be folded up so as to occupy very little space, and the whole device is so exceedingly simple that its manipulation can be readily understood by any one, and is not liable to get out of order. The entire weight of the device is only 9 pounds, while it is graceful in appearance and handsomely finished. The legs are of iron, japanned; the standard is nickel-plated, and the top of polished black walnut.

To adjust the top, which is made in sections, to suit different sized books, the sections are drawn apart the distance of the thickness of the book. In opening or closing the book, the sections of the top work with the cover of the book, and act automatically, the same device serving both purposes of holding the book open and holding it closed. The holder is adapted to the wants of students and professional people of all classes; for the offices of merchants to hold books of reference, such as mercantile reports, etc., and for general use at home for dictionaries, family bibles, etc. It also makes a complete music stand.

This very convenient device is manufactured by R. M. Lambie, 103 Fourth avenue, New York city.

Cements.

The following observations upon cements may be found useful. It has been ascertained that cement that has been prepared by grinding with mill-stones, has only half the firmness that it shows when ground in centrifugal machines. The difference is explained by the fact that the centrifugal mode of grinding yields a much more finely divided product, which increases the hardening quality of cement mixed with sand. Coarse sand gives the highest degree of solidity and firmness to cement. It is unnecessary, when coarse sand of one sized grain has been used with cement, to mix finer sand with it to fill up the interstices of the mixture, as other indifferent substances can be used with equally good results. Moist carbonic acid has been found to diminish the firmness of cement to a considerable degree, and in a short space of time. The great difficulty encountered in manufacturing marble imitations from cement, is to prevent the cracking of the latter. Cement cracks when it is made up with too much water. It then forms a vitreous crust, and is not homogeneous throughout its mass. By adding finely crushed granite fragments to cement without sand, a material is obtained that has great hardness, and which is susceptible of taking a high polish.

A New Builders' Exchange.—A meeting of those interested in the establishment of an exchange in the interest of the building material men was held on March 13th, at No. 18 Coenties slip, at which time the committee appointed at a previous meeting reported a constitution and by-laws which were adopted. The title determined upon is the Building Material Exchange of the City of New York. The entrance fee has been fixed at $25 until May 1st, and the annual dues at not less than $10 or more than $20. The committee were empowered to engage suitable quarters for the transaction of business, which they have since done at No. 12 Dey street. They have already over one hundred names on the roll and the first annual meeting will be held on the second Monday in April.

Market Report of Building Materials.

NEW YORK PRICES.

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LUMBER.

Pine, very choice and extra dry, ₱ M	$60 00 @ 70 00
Pine, good	55 00 @ 60 00
Pine, shipping box	21 00 @ 22 50
Pine, common box	18 00 @ 20 00
Pine, common box ⅝	16 00 @ 18 00
Pine, tally plank, 1¼, 10 inch, dressed each	— 44 @ — 50
Pine, tally plank, 1¼, 2d quality	— 35 @ — 38
Pine, tally plank, 1¼, culls	— 28 @ — 30
Pine, tally boards, dressed, good	— 30 @ — 32
Pine, tally boards, dressed, common	— 25 @ — 28
Pine, tally boards, culls, dressed	— 23 @ — 25
Pine, strip boards, merchantable	— 18 @ — 20
Pine, strip boards, clear	— 24 @ — 26
Pine, strip plank, dressed, clear	— 33 @ — 35
Spruce boards, dressed	— 25 @ — 27
Spruce plank, 1¼ inch, dressed	— 28 @ — 30
Spruce plank, 2 inch	— 43 @ — 45
Spruce wall strips	— 15 @ — 16
Spruce timber, ₱ M	20 00 @ 25 00
Hemlock boards, ₱ M	17 00 @ 18 00
Hemlock joist, 2½x4, each	— 16 @ — 17
Hemlock joist, 3x4	— 18 @ — 20
Hemlock joist, 4x6	— 40 @ — 44
Ash, good, ₱ M	55 00 @ — —
Oak	60 00 @ 65 00
Maple culls	25 00 @ 30 00
Maple good	45 00 @ 50 00
Chestnut	48 00 @ 52 00
Cypress, 1, 1½, 2, and 2½-inch	35 00 @ 40 00
Black Walnut, good to choice	115 00 @125 00
Black walnut, ⅝-inch	85 00 @100 00
Black walnut, selected, and seasoned	150 00 @175 00
Black walnut, counters, ₱ ft	— 22 @ — 28
Cherry, wide, ₱ M	100 00 @120 00
Cherry, ordinary	60 00 @ 80 00
White wood, inch	45 00 @ 50 00
White wood, ⅝-inch	35 00 @ 40 00
White wood, ⅝ panels	45 00 @ 50 00
Shingles, extra sawed pine, 18-inch	4 00 @ 5 00
Shingles, clear sawed pine, 16-inch	3 75 @ 4 00
Shingles, cypress, 24x6	18 00 @ 20 00
Shingles, cypress, 20x6	10 00 @ 12 00
Lath, Cargo rate	2 20 @ 2 25
Yellow dressed pine flooring	30 00 @ 40 00
Yellow pine girders	32 50 @ 40 00
Locust posts, 8 feet, ₱ inch	— 18 @ — 20
Locust posts, 10 feet	— 24 @ — 25
Locust posts, 12 feet	— 29 @ — 34
Chestnut posts, ₱ ft	— 3 @ —3½
Basswood ₱ M	25 00 @ 30 00

Cargo rates 10 ₱ cent off.

BRICKS.

	Cargo.	Afloat.
Pale, ₱ M	4 00	@ 5 00
Up Rivers	—	@ —
Jersey	8 75	@ 9 00
Haverstraw Bay	9 25	@ 9 37½
" " choice	9 50	@ —
Favorite Brands	—	@ —
Hollow Fire-Clay Brick	9 00	@ 9 25

FRONTS.

Croton—Brown, ₱ M	11 25	@ — —
" Dark	13 25	@ — —
" Red	13 25	@ — —
Philadelphia	35 00	@ — —
Trenton	35 00	@ — —
Baltimore	45 00	@ — —
Clark's Glens Falls, White	30 00	@ — —
" " Red Fronts	27 50	@ — —
" " Molded Red and White	45 00	@ 80 00

Yard prices 50 cents ₱ M higher, or with delivery added $2 ₱ M for hard and $3 ₱ M for front brick. For delivery add $5 on Philadelphia, Trenton and Glens Falls and $6 on Baltimore brick.

IRON—PER TON.

Duty.—Bar, 1 to 1½c. ₱ ℔. ; Railroad, 70c. ₱ 100 ℔. ; Boiler and Plate, 1½c. ₱ ℔. ; Sheet, Band, Hoop, and Scroll, 1¼ to 1¾c. ₱ ℔. ; Pig, $7 ₱ ton ; Polished Sheet, 3c. ₱ ℔. Galvanized, 2½c. ₱ ℔. ; Scrap cast, $6 ₱ ton ; Scrap Wrought, $8 ₱ ton—all less 10 ₱ cent. No Bar Iron to pay a less duty than 35 ₱ cent ad val.

Pig, Scotch—Coltness	26 00	@ 26 50
" Glengarnock	24 50	@ 25 25
" Eglinton	23 00	@ 23 75
" American, No. 1	25 50	@ 26 00
" American, No. 2	24 00	@ 24 50
" American forge	22 50	@ 23 00

LEAD—PER 100 POUNDS.

German	— —	@ — —
English, common	— —	@ — —
Spanish	5 75	@ — —
Foreign, refined	— —	@ — —
Bar	6 50	@ — —
Sheet	7 50	@ — —
Pipe	— —	@ — —
Domestic	4 63	@ — —

TIN PLATES.—Duty, 1 7/10 cents ₱ ℔.

I. C charcoal, 10x14, ₱ box	6 25	@ 6 50
I. C. coke, 10x14	5 50	@ 5 75
I. X. charcoal, 10x14	8 25	@ 8 37½
I. C. charcoal, 14x20	6 25	@ 6 50
I. X. charcoal, 14x20	8 25	@ 8 37½
I. C. coke, 14x20	5 50	@ 5 75
I. C coke, terne, 14x20	5 25	@ 5 37½
I. C. charcoal, terne, 14x20	5 50	@ 5 75

NAILS—PER KEG.

10d to 60d, common, fence and sheathing	3 30	@ 3 40
8d and 9d, common	3 65	@ — —
6d and 7d common	3 90	@ — —
4d and 5d, common	4 15	@ — —
3d and 4d, light	4 95	@ — —
3d, fine	5 65	@ — —
2d, fine	5 65	@ — —
Cut spikes, all sizes	3 65	@ — —
Clinch nails, 1½ to 1¾ inch	5 65	@ — —
do. 2 to 2½ inch	5 40	@ — —
do. 2¼ to 2¾ inch	5 15	@ — —
do. 3 inch and longer	4 90	@ — —

SOLDERS.

Half and half	16½	@ — 16¾
Extra	15½	@ — 15¾
No. 1	13½	@ — 13¾

ZINC.—Duty, sheet, ₱ ℔, 2½ cents.

Sheet (cask) ₱ ℔	7½	@ — 7⅝
Sheet (open)	8	@ — 8½

STONE.—Cargo Rates Delivered in New York.

Amherst Sandstone, No. 1, buff, in rough, ₱ c. f.	1 00 @ — —
do do No. 2	— 85 @ — 95
Bedford Stone	1 25 @ — —
Berlin Freestone, in rough	— 75 @ 1 00
Berea Freestone, in rough	— 75 @ 1 00
Brown Stone, Portland, Conn	1 00 @ 1 35
Bay of Fundy Wood Point Brown Stone	1 00 @ — —
do Mary Point Brown Stone	1 00 @ — —
do do Olive Stone	1 00 @ — —
Brown Stone, Belleville, N. J	1 00 @ 1 35
Granite, rough	— 60 @ 1 25
Canaan Marble	1 25 @ 1 50
Sutherland Falls Marble	1 25 @ 1 75
Dorchester, N. B., Stone, rough, ₱ foot	1 00 @ — —

PAINTS.

Carmine, American, ₱ ℔	5 00	@ 5 25
Chalk, ₱ 100 ℔s	— 35	@ — —
China Clay, ₱ ton	18 00	@ 20 00
Chrome yellow, dry, ₱ ℔	— 12½	@ — 28
Lead, red American, ₱ ℔	— 6¾	@ — 7
Lead, white American, pure, in oil	— 7½	@ — 8
Lead, white American, pure, dry	— 6¾	@ — 7
Lead, white English, pure, in oil	— 9	@ — 10
Litharge	— 6¾	@ — 7
Ocher, Fr., dry, ₱ 100 ℔s	1 50	@ — —
Ocher, ground, in oil, ₱ ℔	— 6	@ — 15
Ocher, Vermont, ₱ 100 ℔s	— 75	@ 1 00
Orange Mineral, English	— 9	@ — 10
Paris White, American	— 1½	@ — 1¾
Paris White, English, prime	— 2	@ — 2¼
Paris Green	— 15	@ — 28
Plumbago paint, patent, ₱ ℔	— —	@ — 25
Putty, ₱ ℔	— 2	@ — 2½
Spanish Brown, dry, ₱ ℔	— 1⅛	@ — 1¼
Spanish Brown, ground in oil, ₱ ℔	— 8	@ — 9
Venetian red, ₱ cwt	1 75	@ 2 00
Vermilion, Chinese, ₱ ℔	— 85	@ — 90
Vermilion, Trieste	— 70	@ — 75
Vermilion, quicksilver, bags	— 50	@ — 52½
Vermilion, American, common	— 15	@ — 18
Whiting, ₱ 100 ℔s	— 60	@ — 80
Zinc, white American, dry, No. 1	— 5	@ — 7½
Zinc, white American, No. 1, in oil	— 8	@ — 10
Zinc, white French, dry, (Red Seal,)	— 7	@ — 8
Zinc, white French, in oil	— 10	@ — 10½

VARNISHES—PER GALLON.

American Wearing Body	3 50 @ 4 00
Coach Body	2 35 @ 3 50
" "	1 80 @ 2 00
Furniture	1 25 @ 2 50
Black Asphaltum	1 00 @ 1 50
Brown Japan	1 00 @ 1 20
Liquid Paint Dryer	1 35 @ 1 75
Harness, (black)	3 00 @ 4 50
Shellac, Spirits	3 00 @ 3 50

CEMENT—PER BARREL.

Portland (imported)	2 75 @ 3 50
Portland (American)	2 40 @ 2 65
Portland (Lafarge)	3 40 @ 3 60
Lime of Teil	2 30 @ 2 50
Lime of Teil, ₱ ton	15 00 @ 18 00
Roman	2 75 @ 3 40
Keene's & Martin's, coarse	6 00 @ 6 50
" fine	10 50 @ 10 75
Rosendale	1 25 @ — —

HAIR.

Cattle, ₱ bushel of 7 ℔s	— 16 @ — 18
Goat " "	— 25 @ — 28

SLATE.

Purple, roofing slate, ₱ square	$6 00 @ 7 00
Green Slate	6 00 @ 7 00
Red Slate	13 00 @ — —
Black Slate, Pennsylvania, (at Jersey City)	4 75 @ 5 25
Slate tiles, 1¼-inch, rubbed, ₱ square foot	— 20 @ — 25

PLASTER PARIS.

Duty.—20 ₱ cent ad. val. on calcined ; lump free.

Calcined, ordinary city, ₱ bbl	1 60 @ 1 75
Calcined, city casting	1 80 @ 1 90
Calcined, city superfine	2 00 @ 2 25

LIME—PER BARREL.

State, common	1 15 @ 1 20
" finishing	1 35 @ 1 40
Rockland, common cargo rate	1 20 @ — —
" finishing	1 40 @ — —
Ground	1 15 @ 1 20

Add 25 cents to above figures for yard rates.

MAHOGANY.

St. Domingo, crotches, ordinary to good, ₱ ft	— 15 @ —28
St. Domingo, crotches, fine	— 20 @ —30
St. Domingo, logs, small	— 5 @ —38
St. Domingo, logs, large	— 12 @ —15
Frontera, Mexican, large	— 12 @ —15
Frontera, Mexican, small	— 6 @ — 8
Other Mexican	— 6 @ —12½
Honduras	— 6 @ —12½

ROSEWOOD.

Rio Janeiro, ordinary to good, ₱ ℔	— 2½ @ — 4½
Rio Janeiro, good to fine	— 5 @ — 8
Honduras	— 6 @ — 12½
Satin Wood, ₱ foot	— 15 @ — 75
Tulipwood, ₱ ℔	— 6 @ — 7
Lignumvitæ, large, ₱ ton	30 00 @ 50 00
Lignumvitæ, other sizes	10 00 @ 25 00

CEDAR.

Cuba and Mexican, small, ₱ super. ft	6 @ — 7½
Cuba and Mexican, medium	8 @ — 9½
Cuba and Mexican, large	10 @ —11
Florida, ₱ cubic foot	40 @ —75

DEADENING AND ROOFING MATERIAL.

Mineral wood for Roofs and deadening, ₱ ℔	— 1¼ @ —1½

LABOR.

Ordinary,	₱ day	2 00 @ 2 50
Masons,	do	3 50 @ 4 00
Plasterers,	do	4 00 @ — —
Carpenters,	do	4 00 @ — —
Plumbers,	do	4 00 @ 4 50
Painters,	do	3 00 @ 3 50
Stone-Cutters,	do	3 00 @ 3 50

REVIEW OF THE MARKETS.—In the lumber market during the past month, to meet current consumptive wants, a fair demand has prevailed, and a few dealers have continued on the market looking for standard goods to run into yard, which, in connection with a fair export call, has kept an outlet open for a considerable amount of stock. Business however, has not had an unusually animated or even positively encouraging tone, nor are the prospects for the future sufficiently clear to permit of free action. There is, unquestionably, plenty of work laid out, but how much of it will be carried forward, especially in the building line, has yet to be determined and buyers move with caution, accordingly. At the best, however, it is hardly possible that trade will reach the proportions of last spring on any grade of lumber. On prices we find few important changes, but with one or two exceptions the tone has been easy and the market scarcely in position to withstand pressure.

In the brick market common hards have undergone little or no change during the month. The supply and demand have continued to about preserve a balance with a natural sequence to be found in fairly uniform values, and so far as sellers are concerned we have heard no complaints.

In the cement market signs of irregularity have commenced to appear for imported brands, and the firmness has not been so decided or general in character as at our last writing. That the local and interior demand will want a pretty liberal supply during the year, there can be little doubt, but the imports already exceed those of 1881 by quite a large total; there is more afloat, and buyers are not moving with the same "regardless of cost" manner they did last season, and are more inclined to understand the quality of stock they are to receive. Quotations are continued as before, but there is some uncertainty over actual values.

In the lath market a strong tone has been preserved without an effort, and the expectations of higher prices entertained by receivers have been realized, with $2.40 per M now a fully established rate, and a little inside if anything. Some fair arrivals have taken place, but over one-half disappeared on contracts made before receipts, and the balance was quickly absorbed by waiting buyers and demand not yet satisfied.

In the lime market, without a change in price, there are seldom any very noticeable features, and as there has been no change, matters are void of interest for the month. Receivers have reported rather a moderate and somewhat uncertain demand, but this has found its balance in slow arrivals.

In the hardware market domestic goods have remained, in a general way, quite steady, especially so in what may be called the regular run of standard goods, both of shelf stock and larger descriptions. The supplies have not been large, nor are additions expected to any great extent for some time to come, as manufacturers in many instances are still behind with their contracts. The demand, however, has not appeared to be quite so snappish, and indications of growing caution among buyers may be noted.

In the metal markets American pig has appeared to find an outlet full enough to prevent any serious accumulations in first hands, and there has been, in consequence, an absence of pressure to realize, with prices held fairly steady. The market, however, has evidently lacked solid support, and would scarcely resist any direct pressure. Manufactured iron has been without much general animation for immediate delivery, and few orders have come to hand. About former rates have been named in most cases, but have been somewhat nominal, and rumors have been current of considerable cutting. Domestic pig lead has been offered somewhat more freely, both here and at primary points, and as there has been no demand of a fairly counteracting character values have weakened a trifle. Sheet zinc has been in very good demand, and the market somewhat stronger.

In the market for nails business has shown irregular form, some dealers reporting a very fair movement, and others only a limited outlet for stock. There has not, however, been any positive activity, and evidently supplies have been sufficient to meet all calls, with the turn of prices in buyers' favor.

Building Intelligence.

Architects, Builders and Contractors are invited to send us items of interest for this department. It is our object to notice only the more important operations in building, our space being too limited for the publication of minor matters, which, besides, possess only local interest. We wish to publish only such intelligence as is of general interest.

New York City Building Items.

A plan has been filed to alter the aquarium at No. 1,331 Broadway to a theater. It will have a parquet and parquet circle, and there will be an open space of 10 feet all the way around. Philip Thorp is the lessee.

Charles L. Tiffany has filed plans for the erection of two houses—one to cost $150,000 and the other $50,000—at Madison avenue and Seventy-second street. The first will be occupied by three families, and the second by one. The buildings will be of bluestone, and will be 113 feet high from pavement to roof.

William H. Vanderbilt has bought the lot at the southwest corner of Fifth avenue and Fifty-fourth street, and intends to build on it two dwelling houses, one for his son-in-law, Hamilton McK. Twombly, who is superintendent of the Hudson River Railroad grain elevator, and the other for his son-in-law Dr. Seward Webb. Architects are already busy on the plans.

Mr. Esterbrook, Inspector of Buildings, has drafted a new building law to be submitted to the Legislature. The proposed bill, among its more important clauses, provides that all elevator shafts shall be fireproof; that the erection of fire escapes shall be more general; that better means of egress shall be supplied in public buildings and in the larger tenements, and that theaters shall be made more secure against fire or fatal panic.

Prominent among the many notable private residences, in process of construction in this city at present, and already referred to in these columns, are the houses of Robert Goelet and Ogden Goelet, on the southwest and northeast corners, respectively, of Fifth avenue, and Forty-ninth street. Both are modified examples of French Renaissance, and the interior decorations of Ogden Goelet's house are in every way more striking than the exterior. These decorations are in charge of Louis C. Tiffany. The hall is of English weathered oak, richly carved, with a large fireplace. In the parlor, 20 by 30 feet in size, the ceiling is finished in heavy silks, with gold and silver bronze ornamentation of patterns adapted from studies made in India. The woodwork, in only slightly modified, treatment, is almost a pure example of Indian architecture. The latticed windows will harmonize with their surroundings, and an Indian fireplace, which, at first thought, appears to be a paradox, will be a prominent feature of the apartment. The decoration of the hall and parlor alone will cost upward of $50,000, and the entire interior will present many new and striking features which will be studied with interest when the house shall be completed.

The architectural design and general appearance of the exterior of Cornelius Vanderbilt's house at Fifty-seventh street, and Fifth avenue, in common with the other new homes of the Vanderbilts, has been extensively noticed. G. H. Post is the architect. Briefly, the style is French Renaissance of the period of Francis I., the material is red brick and light gray Ohio stone, with a roof of red slate, and balconies of carved stone, in pierced or open work patterns, The tops of all the windows, large and small, are of stained glass, by La Farge. On the first floor beginning at the main entrance on Fifty-seventh street, is the vestibule; the entrance hall has a reception room at the right, and at the left a stairway leading down to the basement library and billiard hall; the elevator is also reached from the entrance hall, and from this also a stairway leads to the main hall by a rise of a few feet. The main hall is of generous proportions, 46 feet in length by 18 feet in width. The east side of the first floor is occupied by the library and drawing room; opening from the main hall is a small breakfast hall, and on the west side are the conservatory, the dining hall, the water color room and the smoking room. There are five bed rooms on both the second and third floors. On the fourth floor are the servants' rooms and in the attic the bowling alley. From the octagonal tower-room, about 24 feet in size, which is 90 feet above the sidewalk, an extended view of the Park can be obtained. The first floor decorations are designed by La Farge, and are being done under his supervision. The library will be finished in mahogany, with a wainscoting 8 feet high. The walls are 15 feet and 6 inches high, and the ceiling is to be finished in wood with small panels of free work with realistic carving. A large mantel has seats at the side, under an overhanging hood, and is abundantly carved. The drawing-room connects with the library by folding doors; the decoration of this apartment is being done by Tiffany. The treatment is both elaborate and rich to the last degree. The large folding doors on the south side are balanced on the north side by a large cabinet mantel in the wall. There are four pilasters on either side, and these pilasters, together with the wainscoting, which is of maple, are inlaid with classic designs in metal and glass. The whole is being wrought out with rare combination of delicacy and strength, while the color is in agreeable half-tints in light and delicate variation. As in his treatment of the Goelet rooms, where he has for the first time introduced examples of the decorative art of India, so also in the Vanderbilt drawing-room Mr. Tiffany has made another experimental departure. The ceiling of this drawing-room is in mosaics of glass, in small panels. There is a large panel in the center, about nine feet square, in the middle of which is a Moorish design, surrounded by a circle of cherubs. The glass panels of the ceiling are subdivided by demarcations of woodwork in geometrical designs. The woodwork of the main hall is of carved oak in the most elaborate patterns. Around the room is a wainscoting of oak, 10 feet high, the upper part being ornamented with bronze patterns and carvings. A fireplace of expansive proportions directly faces the main entrance. A stairway of carved oak leads to the upper floors. Opposite these stairs, and fronting on Fifty-seventh street, is the cozy breakfast room, 14 by 22 feet, decorated in the latest French style, with delicate lines and soft tints, garlands of flowers done in the old Santa Domingo oak, and everything in exquisite taste. An alcove and deep bay-window add to the attractions of the room. The dining-room an appropriate counterpart of the main hall, which gives the key-note to the largeness and completeness of the plan on which everything about the house, is done. It is 23 by 45 feet in size, and is finished in oak, the decorations being by La Farge. There are stained glass panels in the ceiling, and at the sides inlaid panels of different colored marbles and bronze. On one side of this room is the conservatory, and on other the water-color cabinet. Beyond this cabinet and the list of apartments on the first floor is the smoking-room, which on one side looks into the garden (that is to be), and on the other into the windows of the house (that is to be, also) of Mr. Vanderbilt's friend, Wm. Hutchinson. It may be said here that Mr. Hutchinson's house will face on Fifty-eighth street, that it will be 35 feet front by 80 feet in depth, and that it will be built of Wyoming Valley bluestone and red brick, treated after the French school. It is to be four stories in hight, with a basement, will cost in the neighborhood of $100,000, and is to to be ready for occupancy next fall. Returning to Mr. Vanderbilt's house, the halls of the upper floors are all in oak, the decorations of the bed-rooms being in charge of Herter Brothers. The bath-rooms are entirely separate from other rooms, and there is no running water in any of the rooms. The Fifth avenue front of the basement contains a library and the billiard hall, and there will be also a sort of family-room. The kitchens, scullery and other working departments are in the west side of the basement. The outside of Mr. Vanderbilt's house is all complete; inside, the library is nearly finished, the hall is well advanced and the work in other departments is all in the hands of the contractors. The living parts of the house will be sufficiently advanced for Mr. Vanderbilt to move in early in May, and the entire establishment, it is expected, will be ready for the house warming late in the fall. An estimate of the cost of the building places the figures at $300,000 and the cost of the decorations, exclusive of furnishing, at $500,000. The woodwork of the main hall alone, will cost $50,000.

Miscellaneous.

The Massachusetts Central Railway Company will build a depot at Waltham, Mass., this spring.

At Buffalo, N. Y., the Delaware, Lackawanna & Western Railroad Company will begin to erect suitable buildings for its use at once.

At Mauch Chunck, Pa., the Lehigh Valley Railroad Co. are about building a very fine four-story brick block, with Sutherland Falls marble finish, on the site of their present location, to be used for offices of the railroad company.

A memorial laboratory is to be erected for Yale College, New Haven, Conn., by T. C. and Henry T. Sloane, of New York, in honor of their father. The plans are being prepared by a New York architect, and the building will, it is expected, cost about $50,000.

Wm. A. Mundell is engaged on the plans for three five-story brick factories, to be erected on Adams street, between Myrtle and Willoughby avenues, Brooklyn. Two of them will be 25 by 93 feet, and the other 25 by 50 feet. The owner is Ex-Mayor Howell.

W. W. Larmour, of Waco, Tex., has completed the plans and let contracts for a three-story storehouse, 91 by 125 feet, for Cleveland & Cameron, of that place, to cost $22,000. Mr. Larmour is also making plans for a costly residence for Geo. W. Cleveland, of the above named firm.

At Woodberry, Md., a three-story town hall, is to be erected. It is to be 43 by 94 feet, and to be, built of brick, first story to consist of four stores: second story, hall and stage; third story to be used as Masonic Lodge Room; cost, $25,000. The architects are J. A. and W. T. Wilson, Baltimore.

The Postmaster-General has entered into an arrangement with Robert A. Hool, of Washington, for the erection of a building at Eight and E streets, for the accommodation of the money-order division of the post-office and the money-order division of the treasury for the post-office. The building is to be ready by October 1st.

The Ocean Point Company proposes to make extensive improvements upon 1,200 acres of land, recently purchased by them on the Atlantic coast extending from Woodsburgh to Lawrence, L. I. Edward H. Frame, of Flushing, has been appointed general superintendent and constructing engineer. J. M. Peck is building a hotel, 50 by 100 feet, with a 25-foot extension, in the Queen Anne style, on the property.

At Topeka, Kan., the Atkinson, Topeka & Santa Fé Railroad Company has filed applications for building permits for the following new buildings, seven in number, the total cost of the same to be $132,500: New round-house to be built of stone, 80 by 614 feet, to be located upon the block bounded by First avenue, Crane street, Washington avenue, and Adams street, and to cost $9,000. New coal building, 32 by 100, feet, northwest corner of Washington and Second streets; cost $7,500. New temporary erecting shop, 40 by 133 feet, on Crane street, near Adams street; cost, $3,500. New brick building on Adams street, near Crane street; cost, $2,000. New pattern-shop, of brick, stone and iron on Adams street, between Crane street, and First avenue; cost, $10,000. Addition to machine-shops, to be of brick, 70 by 208 feet, corner of Crane and Adams streets; cost, $50,000.

Vision.

We continue our extracts from the excellent article of Mr. Samuel L. Fox (of James W. Queen & Co., Philadelphia), on "The Eye and its Imperfections," by a consideration of the malformations that produce imperfect vision.

Myopia, or Near-Sightedness.—The difficulty to see distant objects distinctly arises from a defectively constructed eyeball, the distance from the lens to the retina at the back part of the eye being too great, and, as a consequence, the rays of light coming from a distant object are bent to a focus before reaching the retina, and form on the retina only confused pictures

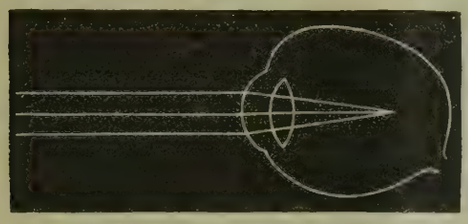


Fig. 3.—Diagram of a Myopic Eye.

(see Fig. 3). Myopia is a condition of the eyes existing at birth in most of the cases where it is discovered, but it may be contracted in youth by long continued application to reading, writing or sewing, particularly where the light is poor and the head is held close to the work to overcome the want of light. It then may be due either to the failure of the muscle of accommodation to relax itself, or of the lens to regain its normal form. Near-sighted eyes are generally large and quite prominent, and require concave lenses to correct their defect. Such eyes, especially in young people, are rarely healthy eyes; and in wearing glasses they should only do so by the advice and careful measurement of the oculist. Myopia is all the more serious from the widespread impression that near-sighted eyes are unusually strong.

It is not proper to conclude hastily that a person is near-sighted simply because small objects are brought closer to the eye than natural to see distinctly, as there are other defects which require the objects to approach the eye for good sight.

Myopia, although transmitted from parents to children, is seldom noticed before the seventh year of age; but after that it begins to manifest itself in those

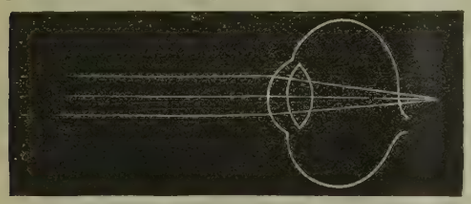


Fig. 4.—Diagram of a Hypermetropic Eye.

whose antecedents predispose them to it. But myopia is liable to be contracted by children of families where a near-sighted member was previously not known. It may then be the result of a prolonged and steady looking at an object, or at objects near the eye, though at proper distance, without rest or frequent change of the visual focus, as in long and absorbed novel reading, intense study, or persistent diligence in needle-work. The practice of reading or otherwise using the sight at too short range; this results in part from insufficient light, or from its faulty direction, so that the hand or body throws a shadow on the page, or the direct rays fall upon the eye, causing undue contraction of the pupil, while the page is in shadow. A prone or forward position of the head too long maintained, or frequently repeated, and becoming a habit; this results from reading or studying with the book in the lap, and from the use of desks not graded to the hight of the pupil. Donders says: "In the hygiene of myopia, the very first point is to guard against working in a stooping position."

Near-sighted people who have inherited myopia, often grow more or less near-sighted as they advance in life; but those who have contracted it between their seventh and twentieth years are specially apt, than otherwise, to find their near-sightedness growing more annoying year by year. Abandoning the injurious causes that have induced the myopia, and correcting with proper lenses the existing trouble, is now the only preventive to the onward progress of the disease.

Myopia is an accompaniment of civilization, being, it is said, almost unknown among barbarous nations. It is rare among the poorer classes, and of these the inhabitants of cities, from the nature of their occupations, are more liable to it than inhabitants of the country.

When myopia is of a low grade, glasses need only be worn for seeing distant objects, but when the number for distance reaches No. 10, another and less powerful glass should be used for reading and sewing.

Hypermetropia.—Hypermetropia arises from a defectively constructed eyeball, but it is the reverse of myopia, being too short from the lens to the retina, consequently the rays of light from distant objects are not sufficiently bent so that they will come to a focus on the retina, when the accommodation function of the eye is not exercised. The impressions of the object formed on the retina are then confused, very much the same as is the case with myopic eyes. Hypermetropia is also a birth inheritance, where it is found to exist in after years, though old-sighted people are apt to become hypermetropic after their sixtieth year. Convex glasses are required for correcting the defect in hypermetropic eyes.

Physicians who give their special attention to the eye and its defects, tell us the most frequent occurring cause of weak eyes is this defect called hypermetropia. Nature has made it possible, however, for persons having such eyes, to see distinctly by making their crystalline lens stronger—that is, shortening its focal length, so that the focus is brought forward on to the retina, and they see for the time being distinctly. This is done by means of the ciliary muscle, situated near the circumference of the lens within the eyeball. In order to maintain distinct vision, this muscle of accommodation must be kept in a constant state of tension, under which it soon becomes exhausted, and gives up, or contracts spasmodically, at first causing blurred and indistinct vision, finally causing pain which may be felt in the eye, but is oftener referred to the forehead and temples. This malformation is often the undiscovered cause of the headaches and neuralgias from which so many persons are constant or periodical sufferers. This, too, is one of the fruitful causes of the sick-headaches, etc., which are the penalty frequently paid for an evening spent at a lecture or place of amusement, or at church; the burning in the eyes, etc., being laid to bright gaslight, when in reality it was caused by the strain upon the little muscle within the eye in maintaining distinct vision. The extreme annoyance it is possible to occasion by muscular strain will be vividly illustrated by holding a moderate weight in the hand at arm's length, without interruption, for half an hour, or even less.

Many a person with a low degree of hypermetropia gets through life until adult age, all the while doing a large amount of eye work, without glasses, and, although feeling great inconvenience in the head, has no idea that defective eyes are the cause of the trouble experienced. Such persons will find entire relief from these annoying and painful symptoms by a properly adjusted pair of glasses, which act by assisting the crystalline lens of the eye, and thus removing the necessity for the muscular strain. The correct plan is to apply the remedy as early as the defect is discovered, whether that be in childhood, youth or mature age. The truth is, that many children attending school suffer from this trouble, while thought by their parents and instructors to be near-sighted.

Internal Squint.—This affection of one or both eyes, producing the deformity called "cross-eyed," is, in a great majority of cases, the result of the eyes being hypermetropically formed. As the eyes are too short from the cornea to the retina, no distinct pictures of distant objects are formed on the retina without an effort on the part of the ciliary muscle to shorten the focus of the crystalline lens, which, in the perfect eye, is not required, except for seeing objects close at hand. Now, the ciliary muscle never contracts without being accompanied by a contraction of the external muscles of the eye, which turns the balls

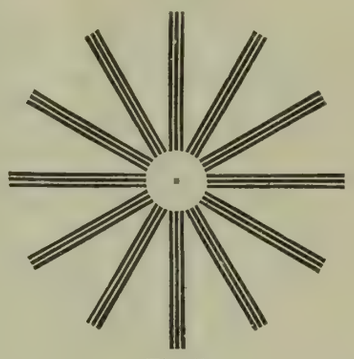


Fig. 5.

inward towards the nose. Persons, therefore, who have hypermetropically formed eyes, when looking at distant objects, instead of having the axes of the two eyes parallel, really have the axes inclined towards each other, one eye generally more than the other. It is very rare to find in eyes affected with the tendency to internal squint the absence of hypermetropia; and it is also rare to find a case of internal squint between the ages of ten and eighteen years, that cannot be cured by a pair of convex spectacles of the right power to correct the hypermetropia.

Astigmatism, or Cylindrical Eye.—In the perfect eye the cornea is nearly the segment of a sphere, and the pupil is about opposite the center or apex of that sphere. But it frequently happens that the cornea is not the segment of a sphere, but is more convex in one direction than in another—in other words, of unequal curvatures in directions at right angles to each other. The consequence of this irregularity upon the sight, is, that while the eye may be perfect for seeing

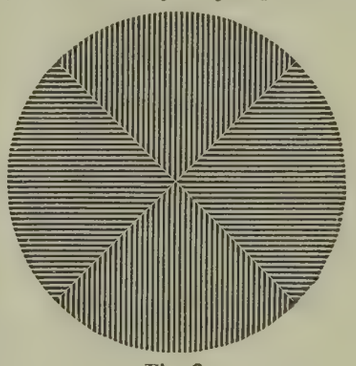


Fig. 6.

objects that are perpendicular, it is defective at the same time for seeing horizontal objects, or *vice versa*. An astigmatic person generally holds objects close to the eyes in order to enlarge them, and so in a measure compensate for the loss of sharpness of vision. When looking at a series of parallel lines likes those illustrated in Figs. 5 and 6, an astigmatic eye will often only be able to see one set clearly, those in the reverse direction being blurred and indistinct. People having a high degree of astigmatism frequently consider themselves near-sighted, and are surprised, when attempting to obtain glasses, that none can be found among concave glasses that will greatly improve their

vision. Children who learn to read with difficulty, annoying their parents and teachers by their apparent stupidity, are generally troubled with astigmatism, which can only be remedied by cylindrical glasses, carefully ground to the oculist's order after accurate measurement of the defect.

The eye may be myopic and astigmatic at the same time, or hypermetropic and astigmatic, or simply astigmatic. To correct astigmatism of the eye and render good and comfortable sight possible, a lens must be selected one surface of which is the segment of a cylinder; this, by its concavity or convexity, and placed in proper position, will correct the defective curve of the cornea without interfering with the more perfect curve of that cornea.

[*To be Continued.*]

Ventilation.

With respect to ventilation, it is the thing that the natural man abhors. In reference to it, we feel inclined to paraphrase that which has been said about charity, namely, that it is an emotion of the mind in which A never sees B in want, without desiring to relieve him, not with the goods of A, but with the goods of C. Similarly, it may be said that when A feels the atmosphere of a room stuffy, he desires it to be changed, not at the risk of himself, A, catching cold, but at the risk of B, or any person other than A. If a proof of this were wanted, it may be found in any assembly where there is some big man whose orders are taken—a judge on the bench, or the chairman of a meeting. What is the direction to the attendant when the judge or chairman feels there is a need of ventilation? "I feel the air of this court or room very close: open two of those windows down there;" not "open two of those windows near me." The big man with natural fear of ventilation, lets somebody else bear the burden, while he himself gets the benefit. It is very rarely, indeed, that the man "down there" has either the readiness or the courage to protest. The only instance that occurs to us of the kind is that of Sidney Smith, when, as curate, sitting at a dinner attended by the higher orders of the clergy, he said to the waiter, who was about to open a window close by, "Don't give me my death of cold: open one behind a bishop."

Manufacturers' Catalogues.

Catalogue of Knowles' Steam Pump Works.—This enterprising establishment has just issued a new catalogue, relating especially to the applications of the Patent Independent Condensing Apparatus, of which we lately printed a descriptive article. The new catalogue is handsomely illustrated by admirably executed engravings showing a variety of applications of their apparatus, and is printed in first-class style on heavy tinted plate paper, making, with the colored cover, a model specimen of printing. The cover is embellished with a neat and original design showing the development of the steam pump from the time of Hero of Alexandria, B.C. 200, to Knowles, A.D. 1880.

The Ashcroft Manufacturing Co., "Original Steam Gauge Works," with offices and salesrooms at 111 Liberty street. this city, likewise announce their intention of issuing a new catalogue of their specialties, and request us to give publicity to the fact. They propose to illustrate the work with a number of entirely new cuts, which they are having made by the best designers and engravers in the country. Though the new catalogue will be devoted exclusively to the description of goods of their own manufacture, they express their intention of making it "the most complete book on steam gauges and special appliances for steam boilers ever issued." We take pleasure in laying the notice of the company's intentions before our readers, and offer our congratulations to them upon this obvious indication of the business prosperity that waits upon enterprise.

Catalogue of Arthur E. Rendle.—We have just received a new and fully illustrated catalogue issued by Mr. Rendle, descriptive of his several improved systems of glazing without putty, which we have commended in several articles published in this journal. Mr. Rendle's catalogue forms a pamphlet of 44 pages of quarto size, and comprises besides a detailed description of his patented methods of glazing, a number of tasteful illustrations of railway stations, exhibition buildings, manufacturing establishments, conservatories, plant houses, etc., to which his glazing has been successfully applied. Mr. Rendle's systems have already met with decided approval in this country, though they have only lately been brought prominently to the notice of the American public, and their extensive adoption here, as in Great Britain, is only a question of a little time.

Catalogue of Manning, Maxwell & Moore.—We have been requested to make the announcement that the above named firm, well known to our readers as extensive manufacturers of and dealers in all kinds of railway and machinists' tools and supplies, are engaged in the collection of material for a new illustrated catalogue, which they announce their intention of making the most complete book of its kind ever issued. They estimate that it will embrace about 400 pages, and they propose to make it a useful and reliable hand-book for the use of dealers and consumers in their special lines of business.

They desire also that we should extend to any of our patrons who have desirable specialties which they wish to incorporate in this catalogue, an invitation to send to the firm duplicate lists of their goods, and that when they are ready the firm will send for electrotypes. We take pleasure in giving publicity to the intention of this enterprising firm, and in extending their invitation to our patrons to participate in the prospective advantages which their new catalogue will afford.

For the information of such of our patrons as may desire to avail themselves of this opportunity, we add the address of the firm in question, namely, Manning, Maxwell & Moore, 111 Liberty street, New York.

The Consolidated Safety Valve Company, of this city, manufacturers of the nickel-seated pop safety valve, embracing the valuable inventions of E. H. Ashcroft, of Boston, Mass., and George W. Richardson, of Troy, N. Y., have advised us of their intention to issue forthwith a complete illustrated work devoted exclusively to the subject of safety valves. This will treat of the inefficiency of the present form of lever valve, and will contain an exposition of the merits and advantages of the type of automatic valve made by them, which merits and advantages have received unqualified confirmation from the testimony of expert engineers and the practical experience of steam users. The proposed work will likewise contain diagrams showing the relative areas of opening of the different sized valves, and will contain illustrations of safety valves suitable for all types of steam boilers.

The whole subject of safety valves is of the greatest importance to steam users and to the public, and the claims of this company to such substantial improvements in the construction of these indispensable devices as to render them absolutely infallible, are worthy of careful consideration, especially when these claims are supported and confirmed by the eminent and trustworthy testimony of a body of chief engineers of the United States Navy, to whom was confided the duty of testing the nickel-seated pop safety valve, in comparison with those ordinarily used on the boilers of the United States Navy vessels. The record of these important tests has been published, and we may at a future time take occasion to refer to them. They demonstrate unmistakably the necessity of modifying the laws now in force respecting the form and character of safety valves employed on steam vessels.

The officers of the company claim to have in their possession hundreds of testimonials from those who have used their valve for years, in which uniform testimony is borne to the fact that during its use they have never required regrinding in their seats, and that they have never failed to open at the point of adjustment and to fully relieve the boiler from any excess of pressure.

We shall look with interest for the appearance of the work whose publication we have taken this occasion to notice, and at the proper time shall doubtless be able to lay before our readers some of the instructive facts and conclusions which we anticipate it will contain.

The organization of the Consolidated Safety Valve Co. is as follows: President and General Manager, Chas. A. Moore; Treasurer and Secretary, Martin Luscomb; Assistant Treasurer, H. S. Manning; Superintendent, Geo. W. Richardson; Directors, Wm. Rousseau, E. L. Maxwell and C. E. Maxwell, with offices at 111 Liberty street, New York.

Miscellaneous and Advertising.

The H. B. Smith Company, will remove from 8 Dey street, to the commodious store No. 137 Center street, on May 1st.

Smith, Vaile & Co., of Dayton, O., have materially enlarged their steam-pump works, and are running over-time to fill orders. They have made many improvements in their patterns during the last year.

W. T. Comstock the well-known architectual book publisher, formerly at 194 Broadway, has moved to No. 6 Astor Place, where he occupies the store and basement, and has fitted up his show-room in elegant style with a full line of his books and architects' supplies.

"How to Keep Boilers Clean," and other valuable information for steam users and engineers. Book of 64 pages. Published by James F. Hotchkiss, 84 John street, New York. Mailed free to any address.

The Curtis Regulator Co., of Boston, Mass., have just received an order from the New York Steam Co. for 175 pressure regulators (from 1 to 3 inches), on account of their contract to supply all the regulators used in the district system of steam heating in New York and Brooklyn.

The Cope & Maxwell Manufacturing Co., of Hamilton, O., have recently shipped to Atchison, Kan., for the water works of that city, two vertical direct-acting plunger pumping engines, fitted with their patent "Isochornal," or self-governing valve gear. They are continually adding improved appliances, and steadily increasing their force.

The Penfield Block Company, of Lockport, N. Y., have during the past season built a large forge-shop, which burns ten soft and three hard coal fires, and employs twenty-five men. The entire force is now over eighty hands, a number which is not surpassed by any similar establishment in the world. They report a rush of work in all branches, especially in their warehouse-truck and wrought-iron block department.

Design for a Country House.

BY D. T. ATWOOD, ARCHITECT.

In calling attention to the country house represented on the opposite page which was erected recently at Joliet, Ill., the architect takes pleasure in the opportunity afforded to express his appreciation of the intelligent aid rendered him by his client, J. H. Winterbotham and family, in the arrangment of the interior and the selection of tints for painting.

It is quite a comfort, as well as a satisfaction to an architect, called upon to design and detail for the erection of a building he cannot personally superintend, to feel that the thoroughness and sympathy of his client can be trusted, and not mar the effect and usefulness of a design by hasty and ill-advised changes. The tact which is always at hand to supply a proper suggestion, lending, as it were, sight and sense to the distant workman, is not so commonly exercised, as it might be, for mutual aid and benefit.

The arrangement of the first and second floors for family use and comfort is, apparent, upon referring to the plans. The hall is a large reception room, in itself, with an open fire, and with the dining-room, parlor and library can be opened—"en suite"—at pleasure.

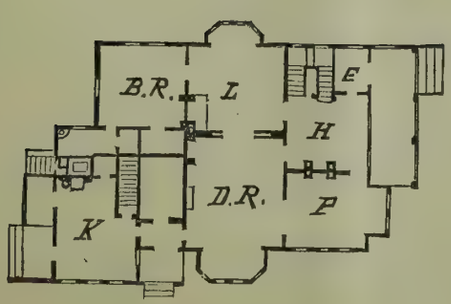
The bed room on the first floor is conveniently arranged for communication with the front and rear portions of the house, and has ample closet accommodation, and a well arranged and fitted bath room.

The kitchen, with northeasterly exposure, is large, and properly ventilated, with two additional flues in the chimney stack. There is a hood over the range to control the current of air and vapor. Double pantries are accessory conveniences—one a china and plate closet, with extra fittings, are reached from both the kitchen and dining-room, besides minor closets.

The second story furnishes six spacious bed rooms, besides dressing-room and closets; and the third story, two rooms for servants and three for general purposes. Nearly all are provided with flues for ventilation which, in connection with the heating apparatus, can be made to perform efficient and healthful service.

The basement is devoted to laundry, furnace and storage uses. Interior finish is substantial and tasteful without being costly. The exterior is painted with dark rich colors, carefully selected, and applied in a manner to give a subdued play of light and shade upon the surfaces, and harmonize the angles and projections of the façades and roof with the general outline of the building. The estimated cost of this house is $6,600.

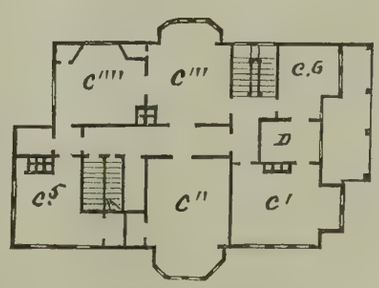
DESIGN FOR A COUNTRY HOUSE.



First-Floor Plan.

COST OF CONSTRUCTION,

$6,600.



Second-Floor Plan.

Home Clubs.

About two years ago a scheme for apartment houses on a new plan was organized in this city. They are called "Hubert Home Clubs," and the following have already been completed, or are in course of erection. To quote from our December number of last year: "a 'home club' is an ordinary joint stock company, limited, and the holder of a certain amount of stock is entitled virtually to a perpetual lease of a certain apartment in the building erected by the company. The object is to afford the occupants not only superior accomodations, but a degree of exclusiveness not attainable in ordinary flats."

The Rembrandt, in Fifty-seventh street, which is finished and occupied.

The Hubert, in Fifty-ninth street, between Seventh avenue and Broadway; it is nearly finished, and will be ready for occupancy May 1st.

The Hawthorne, in Fifty-ninth street, between Sixth and Seventh avenues; the walls are half way up, and the entire building will be finished in the fall.

No. 80 Madison avenue, at Twenty-eight street. This is the central club, and here are the main offices of Hubert, Pirsson & Co., architects of all the Home Club buildings. The exterior is finished; some of the rooms will be ready in July, and all of them in the fall.

The Central Park Apartments, in Seventh avenue, extending from Fifty-eight to Fifty-ninth streets, facing the Park. These are really a combination of eight distinct clubs in one mammoth structure; the excavation for one-half the building is now in progress.

Ground has been purchased, 100 by 110 feet, at the northeast corner of Madison avenue and Thirtieth street. Possession will be obtained May 1st, when work will be begun. The building will contain twenty-six sets of apartments, and will be completed in about a year and a half.

At Fifth avenue and Fifty-fourth street, adjoining St. Thomas's Church. The plot is 100 by 100 feet.

These seven distinct enterprises, which are, however, all conducted on the same general plan, and are a part of the same system, represent an invested capital of $4,600,000 in the buildings alone, and including the ground a total investment of $7,000,000, according to figures furnished by Mr. Hubert.

These clubs, which were originally formed as partnerships or associations, under the new law of the State, have been reorganized as joint stock companies. All the buildings, with the exception of the Rembrandt, are fire-proof; the plumbing has received the particular attention which it demands, and the most satisfactory results have been attained. In matters of ventilation, heating and lighting little or nothing has been left to be desired. Unlike the conventional French flat, the Hubert Home Clubs have no dark or inside rooms, and not a room in any set that does not have light from windows opening either on the street or on a spacious court. The cost of rent to members is nearly 50 per cent less than for similar, and often poorer, accomodations in the same neighborhoods.

The intention at the outset was to provide comfortable homes at low rents for clerks and working people. This part of the experiment is so far a failure. The first club organized was the Farragut, to be situated at Lexington avenue and Eightieth street. Shares cost $2,500; fifteen were wanted and only seven were taken. The apartments were to have been of a character which would readily command from $1,200 to $1,400 a year, and yet the cost to shareholders in the Farragut would only have been $400 a year. This club was given up, and subsequently reorganized, and is still waiting for the number of subscribers necessary to make up the complement. A lot was purchased in Harlem, in 123d, street, between Second and Third avenues, on which to erect a building containing houses for twelve families of workingmen. There were only three subscribers, and the project was dropped and the land sold. Mr. Hubert says he still intends to do something for clerks and mechanics, and that a prominent gentleman, whose practical philanthropy is well-known, has interested himself in assisting to develop some plan of operations that will promise a successful issue. When asked how he accounted for the lack of support from the classes for whom the two last named Home Clubs were projected, Mr. Hubert said that the only way in which he could explain it was that clerks and mechanics were not in the habit of making permanent investments; men of wealth, on the other hand, who are ready to put money into anything that gives satisfactory assurance of a good return, saw at once the desirability of these clubs as permanent investments, and took shares.

The Central Park Apartments, more commoly called the Navarro Apartments, after J. F. de Navarro, the owner of the land on which the buildings for these eight clubs are to be erected, will be, when completed, one of the most imposing structures in the city. There will be a total frontage of 403 feet, and the nine stories will rise to a hight of 125 feet from the sidewalk level. The first two stories will be of stone, and the upper floors of brick. The treatment of the front will be in the Queen Anne style, and turrets, arcades and numerous balconies, together with massive doorways of carved stone, will produce an agreeable effect.

The eight clubs are named after Spanish cities, and are called, respectively, Madrid, Cordova, Granada, Valencia, Lisbon, Barcelona, Salamanca, and Coimbra. A novel feature of the internal arrangements is called the "duplex system," by means of which the number of rooms in each set is considerably increased. Each house or club, with a frontage of about 100 feet, contains thirteen apartments, three of which occupy the whole surface of the building—that is, a surface of 7,800 square feet—and ten of which occupy one-half of the frontage. At the rear space available is doubled by making two ceilings half as high as the one in front. Here are the kitchens, servants' rooms, etc., giving a surface of 4,700 feet.

The entire cost of the building and land for the Home Club at No. 682 Fifth avenue, adjoining St. Thomas's Church, is estimated at $800,000. A large restaurant, to be conducted by a competent caterer, will furnish meals for those who do not care to burden their own households with the responsibilities of the cuisine. By an entrance from Fifty-fourth street, the restaurant will also be accessible to the public.

New Publications.

The American Antiquarian and Oriental Journal. Thomas H. Bush, 65 Washington street, Chicago, Publisher. Editor: Rev. Stephen D. Peet, Clinton, Wis.; Associate Editors: A. S. Gatschet, Washington, D. C.; Prof. R. B. Anderson, Madison, Wis.: E. A. Barber, Philadelphia, Pa.; Prof. J. S. Newberry, New York; Selah Merrill, D.D., Andover, Mass.; Rev. O. D. Miller, Nashua, N. H.; Prof. John Avery, Brunswick, Me.

This magazine occupies one of the most suggestive and instructive fields in all the range of American literature. No department of science is making more rapid progress than archæology, and no country is more prolific in the curious and strange facts which arise in connection with this science than America, Europeans are now fitting out exploring expeditions to Mexico, and European societies are making a speciality of American subjects. It is also said that many European scholars are making more advance in American archæology than the Americans themselves. Fortunately, however, the subject is gaining attention here, and a reasonable supposition is, that American citizens are soon to become as well acquainted with the things which lie at their own doors as those that are at a distance.

The success of this journal may well be regarded as one of the hopeful signs that a thorough and at the same time progressive scholarship is appearing on this continent. It has now reached its fourth volume and numbers among its contributors some of the first scholars in the United States. It has a circulation among the learned societies of this country and Europe and goes into the largest libraries in the world. It has also exchanges with the leading periodicals of this country, with magazines devoted to anthropology and archæology in Germany, France, Italy, England, India, Japan and other foreign countries and by this means reaches the specialists in all countries and secures the attention of the learned of all classes.

Hitherto there has been no special journal on these subjects. Scholars if they would keep pace with the progress of discovery were obliged to take a large number of European journals and to buy many expensive books. There is, therefore, no doubt that professional men and students will find it very valuable, as the subjects to which it is especially devoted are becoming very important, and the effort to gather the many facts which are scattered through so many channels into one journal must be very welcome.

United States Official Postal Guide. Houghton, Mifflin & Co., Boston, Mass. 1882. Price of January No. in paper, $1; in cloth, $1.50; per year, in paper, $1.50; in cloth, $2.

The January number of the United States Official Postal Guide, just out, makes a book of about 820 pages, containing many features which render it most valuable to all who use the mails and wish clear and accurate information about all matters connected with the postal service. It contains alphabetical lists of all post offices in the United States, with county and State; of post offices arranged by States; of post offices arranged by States and counties, with the geographical position of the counties; of the money-order offices, domestic and international; of the post offices of the first, second and third class, with salaries; of counties, and a list of letter-carrier offices; of Canadian money-order offices; information about mailable matter; directions about money orders and registered letters; rates of foreign and domestic postage; all needed information about postal matters. Lists of streets, avenues and money-order offices or stations in New York and Chicago are given, which show where money-orders addressed to persons residing in those cities should be made payable. They will be found of great assistance to parties sending money-orders to these places.

A new and valuable feature in this number of the Guide is a table giving the time of transit of mails between the larger cities of the United States. It includes points in all the different sections of the country, and is so arranged that the time of transit from any given point to another can be readily ascertained. This table will obviate the necessity of consulting a multitude of railway guides for the same purpose, thus saving a deal of valuable time for those who make use of it.

It is important that the general public, as well as postal officials, should understand the postal laws. Under the title "Postal Laws and Regulations," are given synopses of all laws and orders affecting the service, as well as the rulings of the department. These are arranged under appropriate heads, so as to be easy of reference. The ruling will be found to cover almost every point in the construction of the postal laws that may arise. When a point has once been passed upon, the department will refer to the Guide, instead of giving a new ruling.

A monthly supplement is published, containing the latest changes in post offices, postal laws, etc.

Sparks from a Geologist's Hammer. By Alexander Winchell, LL.D., author of "Pre-Adamites," etc. Chicago: S. C. Greggs & Co. 1881.

This highly entertaining volume, the product of a busy scientist's leisure moments, is one of the best specimens of popular scientific writing that it has lately been our fortune to take up. The author is eminent as a geologist, and combines with profound learning the ability to handle the pen in a manner as masterly as he wields the geologist's hammer. His themes are varied; he charms us with a vivid picture of Mont Blanc and its beauties; gives us a masterly exposition, in comprehensible style, of the continents, their age and vicissitudes in the prehistoric ages, and of the arguments and methods and clues by which the geologist is enabled to obtain something of a grasp of the vast periods of geologic time; discusses the question of geological seasons, illustrating the theme by an interesting presentation of the changes that have taken place in the climate of our lake region, and of the changes that have taken place in the character of its fauna; and concludes with a series of philosophical essays, critical and otherwise, embracing such interesting subjects as the doctrine of evolution, its grounds and consequences, and others, which, from their important relations to social and religious questions, are of absorbing interest to intelligent people of all classes.

Prof. Winchell writes excellent English: his style is clear, simple and pleasing, his descriptions are vivid, and his argument logical and forcible, as might be expected of a man thoroughly trained in the rigorous methods of science. The book deserves, and will doubtless have, a wide circulation, and we commend it heartily to our readers as one which will both interest and instruct.

OTHER PUBLICATIONS RECEIVED.

Speech of Hon. Geo. H. Pendleton, of Ohio, delivered in the Senate of the United States, December 13, 1881.

Annual Report of the Chief of Engineers, United States Army, 1881. Washington: Government Print. From the author.

Proceedings of the American Philosophical Society, Philadelphia. Nos. 103–108–109. From the Society.

First Treatise on the Decrease of Water in Springs, Creeks Rivers, etc. By Gustav Wex, Chief Engineer of Improvements of the Danube, Vienna. Translated by Maj. G. Weit-

zel, U. S. A. Washington: Government Print. From the Chief of Engineers.

Instructions to Observers of the Signal Service, U. S. Army. Washington: Government Print. 1881. From the Chief Signal Officer.

Coal. A Weekly Journal of the Coal Trade. Vol. I., No. 1. From the Publishers, the Scientific Publishing Co., 27 Park Place, New York.

Mechanics. A Weekly Journal of Engineering and Mechanical Progress. Vol. I., Nos. 1 to 4. From the Publisher, David Williams, 83 Reade street, New York.

Contributions to the Theory of Blasting; or, Military Mining. By H. Höfer, Prof. School of Mines, Przibram. Part II. Translated by Capt. Chas. W. Raymond, U. S. A. Washington: Government Print. 1881. From the Chief of Engineers.

This department is intended to furnish, for the benefit of all our readers, information on any subject of a scientific or technical character falling within the field of The Manufacturer and Builder. *Any of our readers possessing additional or more correct information than that which we give relating to the questions, are cordially invited to communicate it to us for publication. We also request that all questions or answers be written on separate pieces of paper, and addressed to the Editor.*

QUESTIONS.

(2972) Emery Wheels.—Will you please inform me how emery wheels and stones are made.—E. H. C., East Rochester, N. H.

(2973) Sylvester's Process for Making Brick Masonry Impervious to Moisture.—I saw in a late number of your journal a reference to Sylvester's process for making brick masonry impervious to moisture. Can you give me the process in detail, or refer me to a full description of it?—F. J. P., New York City.

(2974) Restoring Engravings.—Will you please inform me if there is anything that can be put on an old steel engraving to brighten the ink, after the picture has been bleached with chloride of lime and oxalic acid?—E. A. B., Springfield, Mass.

(2975) Paint for Iron-Work.—What is the best paint for iron-work exposed to the weather? What is your opinion of the processes of Messrs. Barff and Bower? and are either of them used in this country?—F. A. O., Atlanta, Ga.

(2976) Wikerscheimer's Fluid.—Can you tell me something about the "preservative fluid" known as "Wikerscheimer's fluid," for preserving animal and vegetable substances against decay and putrefaction? Can the material be purchased in this country? or can you give the formula for preparing it?—E. A. T., Montgomery, Ala.

(2977) Sugar from Sorghum.—For some years past I have been studying the subject of manufacturing sorghum, and have come to the conclusion that I have succeeded in devising machinery and a process that will answer much better for the purpose than any now in use. In your February number for 1882, in answer to Query 2948, I find information that I wish to make available—that is, to obtain the assistance of the Franklin Institute Committee of Science and Arts to make an examination and report upon the merits of my process and machinery. On page 44 of the same issue, I also see that you were elected to the honorable position of Secretary of the Institute, therefore I address you as a very direct way of communicating a knowledge of my wishes to them. In common with many others who spend their time and means in investigating the laws of Nature, I am richer in ideas than in dollars and cents. Hence it is necessary for me to know to what extent I shall be obligated before they undertake the task. I have not applied for a patent, and reserve all rights and the privilege to do so. I want a formula that will enable me to build evaporators with steam-heated pipes, that will evaporate a given number of pounds of water or juice, in a given time, from a given surface, at a temperature (in the evaporating pipes) varying from 14 to 18 pounds pressure per inch, employing steam with varying pressure of 60 more or less indicated on the gauge of the steam boiler. I will send photographs of the models and an accurate description, so the committee can readily understand what the plan is. Please inform me what they will do or require.—O. B. J., Honey Creek, Walworth Co., Wis.

(2978) Fire Sand.—What is fire sand? How can it be distinguished from other sand?—B. G. A., Allen's Hill, N. Y.

(2979) Drain Tile Machine.—I would like to learn where a drain tile machine can be procured, for making both pipe and horseshoe tile, to be run by small steam power.—B. G. A., Allen's Hill, N. Y.

(2980) A Steam Boiler Problem.—Water being heated by a pressure of steam at 300 pounds per square inch; if the withdrawal of pressure causes sudden expansion of water into steam, would not the entire withdrawal of fire from under the boiler—also reducing temperature and pressure—have a like effect on all degrees of pressure above 14.8 pounds (atmosphere) and 212° Fah.?—S. N. H., Philadelphia.

(2981) Polishing Shells.—Please inform me in what manner Abalone shells are polished, and what materials are used. By so doing you will greatly oblige an old subscriber.—A. F. H., Santa Clara, Cal.

(2982) Gilding on Ivory and Glass.—Can you inform me how ornamental designs may be produced on ivory or glass by gilding?—L. J. W., Logansport, Ill.

(2983) Zinc Plates for Battery.—Will you advise me of the best way to melt zinc for battery plates. I have made several attempts and have much trouble from the oxidation of the metal, and my plates are not sound.—S. H. R., Hanover Junction, N. J.

(2984) Embossing Wood.—Will you inform me in your Notes and Queries department how the process of embossing wood is done.—W. C. R., Jr., Washington, D. C.

(2985) Glass Coating on Metals.—Is there any practical method of covering metallic objects with glass?—J. H. W., Arcadia, Wis.

(2986) To Learn Short-Hand.—Can you inform me what is the best course to pursue to attain the art of short-hand writing? What is the best book to get? where can I procure it? and what will be the price? Is a teacher needed? or can I learn with the aid of a book only? How long will it take to become perfect in the art? Please answer, and oblige an old subscriber.—L. A. P., Providence, R. I.

(2987) Copying Ink.—Can you give me a receipt for a copying ink that can be used to copy letters without the aid of a press?—J. L., Stroudsburg, Pa.

(2988) Rules for Converting Specific Gravity into Degrees Beaume, and Vice Versa.—Can you give the undersigned a simple rule for the conversion of degrees Beaumé into specific gravity, and *vice versa?* By so doing, you will oblige.—B. W. P., Jr., Nashville, Tenn.

(2989) Colorless Gum Arabic Solution.—How can I make a solution of gum Arabic that will be quite or nearly free from color?—W. T. L., Atlantic City, N. J.

(2990) Anode and Cathode.—What is the meaning of the terms "anode" and "cathode," used in a description of a galvanic battery?—M. B., Davenport, Iowa.

REPLIES.

(2972) Emery Wheels.—The emery wheel proper is a leaden wheel in which emery is embedded by pressure, or, more commonly, a wooden wheel covered with leather and with a surface of emery. The wheel is fastened to a mandrel and rotated by a wheel and band. Its principal use is in grinding and polishing metallic articles, especially cutlery. Those wheels in which the edges are used are grinders, buff wheels, cloth wheels, glazers, etc. When the flat surface of the disk is used, they are known as "laps." The wheels may have coarse or fine cutting surfaces for different descriptions of work. For polishing, flour of emery, crocus, or rouge may be substituted. In machine shops the emery wheel is known as a "buff wheel," among cutlers it is a "glazer." What are now commonly known as emery wheels, are made of emery of various degrees of fineness, according to the nature of the work, mixed with some cementing substance, forced into a metallic mold by powerful compression, and allowed to remain until they have properly set. The different styles of emery wheels are generally designated in the trade by the name of the cementing material; so we have, for example, the "Vulcanite" wheel, which is made of a mixture of emery and rubber, molded to the shape of a grindstone or lap, and vulcanized. The "Celluloid" wheel has celluloid for the cementing material. Gum, resin, glue, mineral cements, etc., are also used, each manufacturer having a formula of his own in the preparation of his wheels. It is an exceedingly delicate operation to produce an emery wheel that shall have exactly the right qualities for its intended uses as a grinding or cutting device. If the cementing material is too hard, it will not wear away quick enough to expose fresh cutting surfaces of emery. If too soft, the wheel will wear away too quickly and much of the effective work of the emery will be wasted. It must not be too tough, nor susceptible of softening under the influence of heat while in use, as it will then produce a glazed surface and the wheel will cease to cut. For many kinds of work, again, it is important that the cementing material of the wheel should not be affected by water. All these facts must be taken into consideration.

(2973) Sylvester's Process for Making Brick Masonry Impervious to Moisture.—An extended account of the Sylvester process for making brick masonry impervious to moisture was given by Wm. L. Dearborn, C.E., in a paper read before the American Society of Civil Engineers, May 4, 1870. From this paper we make the following extracts: The process consists in using two washes, or solutions, for covering the surface of brick walls; one, composed of Castile soap and water, and the other of alum and water. The proportions are, three-quarters of a pound of soap to one gallon of water, and half a pound of alum to four gallons of water, both substances to be perfectly dissolved in the water before being used. The walls should be perfectly clean and dry, and the temperature of the air should not be below 50° Fah. when the compositions are applied. The first, or soap wash, should be laid on when at boiling heat, with a flat brush, taking care not to form a froth on the brick-work. This wash should remain twenty-four hours, so as to become dry and hard, before the second, or alum wash, is applied, which should be done in the same manner as the first. The temperature of this wash when applied may be 60° or 70° Fah., and it should also remain twenty-four hours before a second coat of the soap wash is applied, and these coats are to be repeated alternately until the walls are made impervious to moisture. The alum and soap thus combined form an insoluble compound (an aluminous soap), filling the pores of the masonry and entirely preventing the moisture from penetrating the walls. Before applying these compositions to the walls of an important engineering structure (the back bays of the gate houses of the new Croton reservoir in Central Park), Mr. Dearborn made some experiments to determine the absorption of water by bricks under pressure after being covered with these washes, in order to ascertain how many coats the walls would require to render them impervious. To do this, a strong wooden box was made (put together with screws) large enough to hold two bricks, and on the top was inserted an inch pipe 40 feet long. In this box two bricks were placed, after being made perfectly dry then coated with a covering of the washes in the manner above described, and, after drying, weighed. They were then subjected to the pressure of a column of water 40 feet high; and after remaining a sufficient length of time, they were taken out and weighed again, to ascertain the amount of water they had absorbed. The bricks were then dried and again coated with the washes and weighed, and subjected to pressure as before; and these operations were repeated until the bricks were found not to absorb any water. Four coatings rendered the bricks impenetrable under the pressure of 40 feet head.

(2974) Restoring Engravings.—It is a great mistake to bleach an old engraving with chloride of lime and oxalic acid, or either one of these chemicals, as our inquirer has done. If such powerful bleaching agents are employed, they should be used very cautiously, as will be indicated further on. The "old" appearance of an old engraving is one of the things that it should possess, and it is bad taste to attempt to rejuvenate it to make it appear like a new print. The only treatment that an old engraving should receive is a careful washing in pure cold water. This, if properly done, will remove from the print all that ought to be removed—dirt, dust, fly specks, and the like. To do this properly, a piece of ordinary mosquito netting should be taken, large enough to accommodate the print, and the ends stitched over to allow of the insertion of a stick of wood (a section of a broomstick will answer), to serve as a convenient holder. The print should be laid flat on this, immersed in a bath of clean water, and from time to time moved to and fro under a gentle stream of water directed upon the soiled places. The mosquito netting will serve to support the paper and prevent its tearing. If left long enough in the water and carefully handled in the manner described, the dirt, dust and specks will be found to be very effectually removed, and the print very much improved in appearance. If the paper is much defaced with yellowish or brownish spots—a characteristic which is very common to old English prints—it may be advantageous to apply chloride of lime carefully with a camel's hair pencil to one spot after another, watching its effect closely, and washing off immediately in a stream of water, and thus pencil out the spots until the paper has a uniform tint, commencing at the unimportant places to get into the right way of doing it, and working cautiously up to the important places. This, however, is only a suggestion, which our correspondent may try. If his treatment has injured the surface of the paper, which is very likely, it may *perhaps* be improved by going over its surface with a *very dilute* starch solution, and afterwards calendering the paper by passing through a copperplate printer's press, which may restore the surface and give the print a more lustrous appearance. But this we will not vouch for, and only offer it as a suggestion.

(2975) Paint for Iron-Work.—The advice of Trautwine on this subject, as on most others, is very safe to follow. He gives as his opinion that the best paints for preserving iron exposed to the weather, are prepared from the pulverized oxides of iron, such as yellow and red iron ochers, or brown hematite iron ores finely ground, and simply mixed with linseed oil and a dryer. White lead applied directly, he affirms, requires incessant renewal, and, indeed, probably exerts a corrosive effect. It may, however, be applied over the more durable colors where appearance requires it. Red lead is said to be very durable when pure. An instance is recorded of pump rods in a well 200 feet deep, near London, England, which having first been thus painted, were in use 45 years, and at the expiration of that time their weight was found to be precisely the same as when new, showing that rust had not affected them. When the size of the exposed iron admits of it, the same authority adds that its freedom from rusting may be promoted to a large extent by first heating it thoroughly, and then dipping it into, or washing it with, linseed oil, which will then penetrate into the interior of the iron. For tinned iron exposed to the weather on roofs, rain pipes, etc., Spanish brown is a very durable color. The tin is frequently found perfectly bright and protected where this color has been used, after an exposure of 40 or 50 years. White paint washes off in a few years by the action

of rain. In regard to the Barff and Bower processes for preserving iron, which depend upon the formation of a thin, tenacious film of magnetic oxide upon the surface of the metal, we have no doubt but that they will very effectually protect the iron from corrosion. Whether or not they can be applied economically in practice, is a question that we are not at present prepared to answer. Both of these processes require a special plant of considerable magnitude to be worked on a large scale. We are informed that they are both in use in England, but with what practical success we do not know. Neither of these processes, so far as we know, are in use in this country.

(2976) Wikerscheimer's Fluid.—We have published several articles in relation to Wikerscheimer's preservative fluid in former issues of this journal, to the files of which we refer this inquirer. The following, which we find in a recent number of *New Remedies*, appears to give the latest information respecting its preparation, and our correspondent may find it useful. This liquid, the formula of which was purchased by the Prussian government for public use as a preservative agent, was directed by the inventor to be prepared in the following manner: In 3,000 parts of boiling water dissolve 100 parts of alum, 25 of sodium chloride, 12 of potassium nitrate, 60 of potassa, and 10 of arsenious acid. Let it cool and filter. To every 10 liters of the filtrate add 4 liters of glycerine and 1 liter of methylic alcohol. Soon after its publication, criticisms of the formula were published, showing it to contain various incongruities and incompatibilities. We have not space here to republish the whole of these criticisms. Modified formulæ are given here for the benefit of our readers:

1. (J. Martenson, St. Petersburg.)

Borax	100 parts.
Potassium sulphate	40 "
Sodium chloride	50 "
Sodium nitrate	30 "
Potassium carbonate	90 "
Arsenious acid	20 "
Glycerine	3,000 "
Alcohol	500 "
Water	6,200 "
About	10,000 parts.

The arsenious acid and carbonate of potassium are dissolved together by the aid of heat, and added to the solution of the other ingredients.

2. (Poetz and Flohr, Berlin.)

	For Injecting.	*For Immersing.*
Arsenious acid	16 grams.	12 grams.
Sodium chloride	80 "	60 "
Potassium sulphate	200 "	150 "
Potassium nitrate	25 "	18 "
Potassium carbonate	20 "	15 "
Water	10 liters.	10 liters.
Glycerine	4 "	4 "
Methylic alcohol	¾ "	¾ "

(2977) Sugar from Sorghum.—The only condition necessary for this correspondent to fulfill to bring the subject of his process before the Committee of Science and Arts of the Franklin Institute, is to furnish them with a description and drawings or models of the process and machinery, sufficiently full and explanatory to enable the committee to comprehend the same, and to pass an intelligent judgment. With these facts in possession, the committee will advise him of the merits and demerits of his process to the best of their knowledge. As regards the building of evaporators, etc., which he desires to do, we would suggest that his best mode of procedure would be to put himself in communication with builders of machinery for sugar refiners, stating the duty required of the same, and requesting an estimate of cost. We would refer him, for this purpose, to Messrs. Robert Deeley & Co., of New York, and to Robert Briggs, of 1125 Girard street, Philadelphia. Respecting the last portion of our correspondent's communication, we would inform him that there is no charge or expense of any kind involved in applying for an examination and report of the Committee of Science and Arts of the Franklin Institute. A blank form of application will be sent to him for signature, which should be returned duly signed and accompanied with a full description and with such models, drawings photographs, etc., of the apparatus as will be necessary for an intelligent comprehension of his plans and methods. On receipt of this, a committee will be appointed, and in due time will make a report, of which a copy will be transmitted to him.

(2978) Fire Sand.—Fire sand is the name applied to a variety of quartzose materials, sand or disintegrated sandstone, suitable for employing as a refractory material in making fire brick, linings for furnaces, etc. The closest definition we can give to distinguish it, is to say that it should be a clean, coarse, angular-grained quartz. The coarse-grained sand is better adapted for fire brick making from the fact that it is generally pure and more refractory. It should be, as nearly as possible, pure silica, and especially free from alkalies (potash and soda), and from iron and other metallic impurities. The typical fire bricks are the so-called "Dinas bricks," made in England, and the French and German "silica" bricks. The English Dinas bricks are made of quartz sand or crushed quartz rock. The material is very nearly pure silica, containing very little alumina, and about one per cent of lime—just enough to serve as a binding material for the silica, causing the grains to stick together when the bricks are intensely heated.

(2979) Drain Tile Machine.—For improved machinery for manufacturing drain tile and kindred products, we refer this inquirer to Mr. Thomas Shaw, of 915 Ridge avenue, Philadelphia. Mr. Shaw is the builder of the presses used by the Moorehead Clay Works, one of the largest manufacturing establishments of its kind in the country. They are suitable for making any shape and size of tile or pipe, from 2 inches to 5 feet in diameter. The Moorehead plant was designed to run 10 tons of clay per day, but has been run to 60 tons in 24 hours.

(2980) A Steam Boiler Problem.—This inquirer has evidently in mind the recent experiments of Mr. Lawson, in which he demonstrated that on suddenly relieving the pressure in a steam boiler by the rapid withdrawal of a large volume of steam, the residual water, containing an excess of heat over that corresponding to the pressure, would suddenly flash into steam with sufficient violence to disrupt the boiler by excessive pressure. The conditions obtained by Mr. Lawson in his experimental boiler, with which he succeeded in demonstrating the apparent paradox of producing an excessive and destructive pressure by relief of pressure in the boiler, would not be produced in the hypothetical case stated by our correspondent. The Lawson conditions can only be paralleled by some plan of *suddenly* relieving pressure in the boiler by the abstraction of a large volume of steam. In the case named by our inquirer, the withdrawal of the fire would only bring about the *gradual* diminution of the pressure. The only sources through which the steam and water would part with their heat, would be by radiation and conduction, and this would be a comparatively slow process, as the latent heat of the condensing steam would be transmitted to the water and residual steam. The pressure, therefore, would run down slowly, and the conditions would be very unlike those of the Lawson experiments.

(2981) Polishing Shells.—Spon gives the following facts respecting the methods employed for polishing shells: 1. Marine shells are cleaned by rubbing with a rag dipped in ordinary hydrochloric acid till the outer dull skin is removed, washing in warm water, drying in hot sawdust, and polishing with chamois leather. Those shells which have no natural polished surface, may either be varnished or rubbed with a little tripoli powder and turpentine on wash-leather, then fine tripoli alone, and lastly with a little fine olive oil, bringing up the surface with chamois as before. 2. The shells are first boiled in a strong solution of potash, then ground on wheels, sometimes through one stratum, to show an underlying one, then polished with hydrochloric acid and putty powder. In this operation the hands are in great danger. Shell grinders are generally almost cripples in their hands. 3. *Polishing Mother-of-Pearl.*—Go over it with pumice stone finely powdered (washed to separate the impurities and dirt), with which polish it very smooth; then apply putty powder and water by a rubber, which will produce a fine gloss and good color.

(2982) Gilding on Ivory and Glass.—One plan for gilding ornate designs on ivory or glass, is to paint over the design with a fine camel's hair brush moistened with nitro-muriate of gold. Then hold the glass or ivory thus painted over the mouth of a flask in which hydrogen gas is being generated (by the action of dilute sulphuric acid on zinc scraps). The hydrogen will reduce the gold chloride to metallic gold on the painted surfaces, and the gold film thus deposited will in a short time be found to have considerable luster, when the operation may be stopped. The gold film is exceedingly thin. Another method suggested for the same purpose, which will answer for glass, is the following: Make some gold powder by putting into an earthenware mortar some gold leaf with a little honey or thick gum water, grinding the mixture until the gold is completely reduced to powder, and then washing out the honey or gum by repeated additions of warm water and decantation. Mix the gold powder with a strong borax solution, and paint over the design with it. When dry, place the glass in a stove and give it a considerable heat. This will vitrify the borax and cement the gold to the glass with much firmness.

(2983) Zinc Plates for Battery.—The zinc should be melted cautiously in a covered crucible, and the addition of some rosin or borax when the metal is about at the melting point will be found advantageous to prevent oxidation. Before pouring into the mold, the skin of oxide should be removed from the surface of the melted metal. By observing these injunctions, especially that of not firing too rapidly, there should be no trouble. We fail to see, however, why this inquirer should want to use cast zinc for his battery plates, when they can be made of rolled zinc with much less trouble. His better plan of procedure would be to take a sheet of rolled zinc of proper thickness, cut this to proper size, scratch a groove in it with a steel point, run some sulphuric acid along the groove, and then some quicksilver, and allow the latter a little time to eat its way in. Then turn the plate over and repeat the operation with the other side, when the plate will easily break along the lines.

(2984) Embossing Wood.—Wood embossing, according to Knight, is a process of indenting designs in wood by heat and pressure. The wood is saturated with water, and a cast iron mold of the design heated to redness is pressed forcibly upon the wood. The water preserves the wood from ignition, though the surface is slightly charred. The iron is reheated, the wood re-wetted, and the branding iron again applied. These operations are repeated until the wood fills the mold. Between each operation the surface is cleansed and finally with a scratch-brush, and any desired color may be retained or obtained by the extent to which the charcoal and discolored surfaces are removed.

(2985) Glass Coating on Metals.—The following method has been suggested for coating metal surfaces with glass, which may be found to answer this inquirer's purpose. Take about 125 parts (by weight) of ordinary flint glass fragments, 20 parts of carbonate of soda, and 12 parts of boracic acid, and melt. Pour the fused mass out on some cold surface, as of stone or metal, and pulverize when cooled off. Make a mixture of this powder with silicate of soda (water-glass) of 50° B. With this coat the metal to be glazed, and heat in a muffle or other furnace until it has fused. This coating is said to adhere very firmly to steel or iron.

(2986) To Learn Short-Hand.—The best course to take to learn short-hand writing would be to acquire a certain degree of skill in the art by a course at some school where it is taught. This would most quickly start the student on the way to acquire the art of rapid writing. After a certain degree of skill has been reached, the student is thrown on his own resources to become an expert. This he can only achieve by constant and unwearying practice for years. An intelligent person can teach himself the art with the aid of suitable books of instruction, but his progress will be slow. There are schools for short-hand instruction in New York, Boston, Philadelphia, and doubtless in other cities. The best known of these is the Phonetic Short-Hand section of the Franklin Institute, in the last named city, where the instruction is very thorough. By opening correspondence with Mr. D. S. Holman, who is in charge of this school, or with Miss Ida Craddock, Instructor of Phonography in Girard College, this inquirer may obtain some additional and more useful advice. The system of Isaac Pitman is taught in these schools, and from what little we know of the subject, his is considered the best. His book can be purchased through any bookseller.

(2987) Copying Ink.—The following is a formula for making a copying ink that we have used successfully for transcribing letters without a press: Reduce by evaporation 10 volumes of any of the common writing inks to 6 volumes, and add 4 volumes of glycerine—that is, enough to make up the original volume. Or, make an ink of double the usual strength and dilute it with about its own volume of glycerine. In copying with this ink, the written letter is simply placed in an ordinary thin paper copying book, and a leaf of the latter is pressed down upon it with the hand, as if using a blotter to dry a wet sheet of writing. It is important not to use heavy pressure; passing the hand gently over the surface is sufficient. The letter and copy should be dried of any excess of ink by placing a sheet of blotting paper between the two after the copy is made, and gently passing the hand over them. The mistake that beginners with this ink generally make, is to use too much glycerine. It is better to use too little and add some afterwards if found necessary.

(2988) Rules for Converting Specific Gravity into Degrees Beaume.—The following rules will be found to be approximately correct—at least sufficiently so for all practical purposes—for the conversion of specific gravities into degrees Beaumé, and *vice versa*:

To Convert Degrees Beaumé into Specific Gravity.—1. For liquids heavier than water, subtract the degree of Beaumé from 145 and divide the remainder into 145. The quotient is the specific gravity (water being taken as 1,000). To reduce to the basis of water=1, mark off three decimal points. 2. For liquids lighter than water, add the degree of Beaumé to 130 and divide the sum into 140. The quotient is the desired specific gravity.

To Convert Specific Gravity into Degrees Beaumé.—1. For liquids heavier than water, divide the specific gravity into 145, and subtract the quotient from 145. The remainder gives the degrees Beaumé. 2. For liquids lighter than water, divide the specific gravity into 140, and subtract 130 from the quotient. The remainder will be the degree of Beaumé.

(2989) Colorless Gum Arabic Solution.—A method lately proposed for discolorizing gum Arabic solution is the following: A solution, after being filtered through calico, is mixed with freshly precipitated hydrate of alumina in the wet state, and then filtered through a linen cloth, when a colorless gum solution will result. By filtering the gum solution through a layer of freshly precipitated alumina, it can also be decolorized greatly, and by repeating the filtration several times, a quite colorless liquid is obtained. It will be best, in using these receipts, to aid filtration by using a filter pump, if one is accessible.

(2990) Anode and Cathode.—The terms "anode" and "cathode" refer to the electrodes or poles of a galvanic circuit. The terms were introduced by Faraday. The positive (+) pole is the anode; the negative (−) pole, the cathode. These terms have come into almost universal use.

THE MANUFACTURER AND BUILDER.

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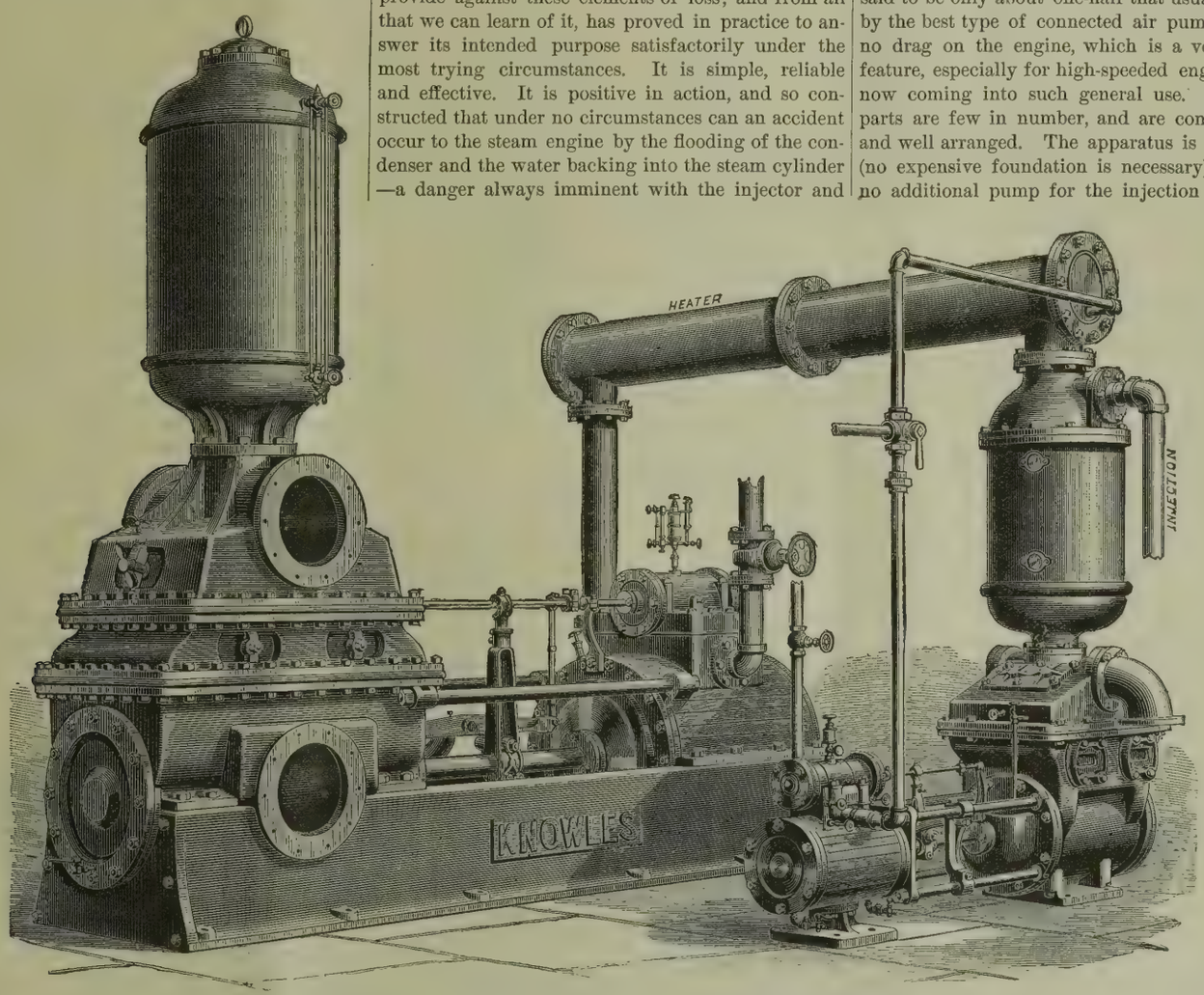
Knowles' Improved Condensing Steam Pump.

The accompanying illustration represents a water-works condensing steam pump of the well-known Knowles pattern, the characteristic features of which have been made the subject of a number of descriptive articles that have from time to time appeared in our columns. The pump in question has a daily capacity of 2,000,000 gallons. The pump is shown rigged with the improved independent air pump, jet condenser and feed-water heater, as manufactured by the Knowles Steam Pump Works, and which formed the subject of a special descriptive article some months ago. The advantages of these attachments on the score of economy in the use of fuel, simplicity and effectiveness, are too obvious to require more than passing notice. To those who have not had the opportunity of reading our earlier descriptions of the character of the independent air pump and condenser, we make the following explanations:

One of the disadvantages of the connected air pump as ordinarily used, resides in the fact that it is necessary to provide an air pump of much larger capacity than is actually required, in order to insure a good vacuum under all circumstances. Another, is the impossibility of regulating its speed, when connected, to correspond to the work that it is called upon to perform, so that it is impossible with the connected air pump to secure the most economical results, or to avoid material loss of power. The independent air pump and condenser of these makers is intended to provide against these elements of loss; and from all that we can learn of it, has proved in practice to answer its intended purpose satisfactorily under the most trying circumstances. It is simple, reliable and effective. It is positive in action, and so constructed that under no circumstances can an accident occur to the steam engine by the flooding of the condenser and the water backing into the steam cylinder —a danger always imminent with the injector and siphon condensers or other forms of independent condensing apparatus. The Knowles apparatus is provided, to meet this contingency, with an automatic float and break-vacuum valve in the condenser. This float, should any dangerous backing up of the injection water occur, rises with it, and in so doing opens a valve in the top of the condenser, to which it is connected by a stem, breaks the vacuum, and thus prevents the flooding of the condenser, and the entrance of water into the steam engine cylinder and the consequent wrecking of the engine. A sectional view of its construction, showing the arrangement of parts, is given on page 4 of our January number for this year, to which our readers are referred, to avoid the necessity of repetition here.

Having no mechanical connection with the steam engine, the air pump can be operated independently and a vacuum formed for the engine before it is started. The speed of the pump can also be regulated according to the temperature of the injection water and the requirements of the engine under different loads. The power necessary to run this machine is said to be only about one-half that usually consumed by the best type of connected air pumps. There is no drag on the engine, which is a very important feature, especially for high-speeded engines that are now coming into such general use. The working parts are few in number, and are compact, durable and well arranged. The apparatus is self-contained (no expensive foundation is necessary) and requires no additional pump for the injection of water, or a head of water to supply the condenser. It will maintain a steady and uniform vacuum (and as high as may be required) no matter how variable the load on the engine may be. A feed-water heater, it will be observed by an inspection of the engraving, is placed between the exhaust connection and the condenser.

These attachments can be placed upon steam pumps of all kinds with benefit on the score of economy. For water works for towns and villages, also for sewerage and irrigation works, they are claimed to represent the simplest and most effective pumping machinery that can be adopted. For use in a mine, or any other place where trouble is experienced in getting



KNOWLES' IMPROVED CONDENSING STEAM PUMP.

id of the exhaust steam, condensing steam pumps are very desirable, for they not only save in fuel, but also do away with the inconvenience and expense of the exhaust pipes, which are always a source of annoyance and damage to the shaft timbering. For oil refineries, iron and steel works, or other places where many steam pumps are in constant use, a great saving of fuel can be obtained by working them on the condensing plan. One of these independent attachments of proper size will take the exhaust steam from all the steam pumps on the place, and thereby not only increase their economy, but do away with the expense and nuisance of having the exhausts going into the atmosphere. The speed of the air pump can be regulated (automatically or otherwise), according to the number of steam pumps that are in operation and exhausting into the condenser. If at any time it is desired to run a steam pump non-condensing, it is only necessary to turn the three-way valve, which should be placed on the exhaust pipe, so that the steam will exhaust into the atmosphere instead of the condenser.

All the working parts of the pumps are made extra strong and of the best materials. In case of accidental breakage or unusual wear, duplicate pieces can be immediately substituted, as the system in use at the Knowles establishment of making all parts from steel gauges, enables the manufacturers to furnish accurate work that will interchange and fit.

Special illustrated catalogues, which will give the inquirer fuller information of the above than we are able to do, may be obtained by addressing the Knowles Steam Pump Works, 86 Liberty street, New York, or 44 Washington street, Boston.

Engineering at Cornell.

Not many years ago, it was a standing and deserved reflection upon the incompleteness of our educational systems, that students seeking for instruction in the higher branches of applied science, were obliged to visit the polytechnic schools of Germany or France. Happily, this is the case no longer, for the urgent needs of our country in respect to higher technical education have been very fairly met by the establishment of numerous special schools of technology, and by the addition to many of our leading colleges and universities of departments of technology. Of these, many have acquired, within the comparatively few years that they have been in existence, a very creditable reputation for the comprehensiveness of their courses and the thoroughness of their instruction.

Foremost among these may be named the Cornell University. We have been specially interested in the excellent character and completeness of the course of instruction in civil engineering at this admirable institution, and which, in these respects, and for the excellence and practical character of the facilities it affords its students in this branch, is highly creditable. As an evidence of the means of professional training in this branch of applied science at the disposal of Cornell University, we append a summary of the course of instruction.

The instruction is given by means of lectures and recitations, with drafting, and field and laboratory practice. The field work embraces the usual operations and the more recent methods of land, railroad, and subterranean surveying, together with hydrography and geodetic practice; and since 1874 the department of Civil Engineering has been engaged in the surveys of the hydrographic basin of central New York, as a contribution to the geodetic surveys of the United States Government.

Laboratory practice is provided in chemistry, mineralogy, metallurgy, geology, physics, and civil engineering.

The students of this department receive instruction in an extended course of mechanics, as applied to engineering, and their professional preparation comprises the following subjects: The location and constructions of railroads, canals, and water-works; the construction of foundations, in water and on land, and of superstructures, and tunnels; the surveys, improvements, and defenses of coasts, harbors, rivers, and lakes; the determination of astronomical co-ordinates; the application of mechanics, graphical statics, and descriptive geometry to the constructions of the various kinds of right and oblique arch bridges, roofs, trusses, and suspension bridges; the design, construction and application of wind and hydraulic motors; air, electric, and heat engines, and pneumatic works; the drainage of towns and the reclaiming of lands; the preparation of plans and specifications, and the proper selection and tests of the materials used in constructions. As a part of their instruction, students have frequent practice in the preparation of papers on subjects of professional importance.

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Vol. XIV., No. 5. Fourteenth Year.

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Plenty of Room for Inventors.

The remark is not infrequently heard that the time is not far distant when the course of invention will be run—when, like Alexander, the genius of invention will weep because there are no more worlds to conquer. The fact that iron fingers have in so many branches of industry been made to perform tasks once done by bone and sinew; that the pulsations of the electric current have outstripped the fleet messenger in the conduct of business; and the iron horse, with food of burning coals, carries the love letter and the meal sack where once the oat-fed country steed galloped along the hard-beaten road—these facts are impressive and suggestive, but not convincing on the subject of an ultimate limit to inventive usefulness or inventive power. The ball of progress, in rolling along, has wrapped about it many a layer of ideas formed into tangible facts; but the periphery grows, and the capacity for enlargement grows with it.

As the circle of knowledge widens, the illimitable space beyond enlarges with it, and though we are continually confronted with the discouraging truth that we have vastly more to learn, we are correspondingly compensated by the knowledge that we have acquired greater ability to learn it.

If the needs of man were the sole gauge of his demands, there might well be a point at which invention, satiated with granting all needful things, might be content to rest. But "to want," means both "to lack" and "to desire." The food and shelter and clothing absolutely requisite, develop the luxuries of the palate and of æsthetic taste. The rude needle of bone that sufficed to sew the bear-skin cloak, and made of it a definite garment, was an invention that might have answered all purposes had the skin garment satisfied; but demand and supply are commensurately progressive; each surpasses the other onward in the march of progress; and now we have that household companion, the sewing machine, purring like a kitten while sewing, basting, hemming and gathering tidily at high speed—this modern sewing machine being as legitimately the outgrowth of the bone needle as the fashionable garment of this latter half of the nineteenth century is the development of the fig-leaf of Mother Eve and the skin covering of her sons.

Our wants have become artificial. With successive generations, what once were luxuries develop into customary grants and eventually become necessities. Our condition is ameliorated, and hence our appreciation sharpened, while certain faculties have become dulled, and invention must supply their places or their deficiencies. Where invention has produced an effect, it is for invention to extend and perfect it. Thus in every walk in life, it is for cunning brain and deft fingers to effect new combinations, or perfect the old, fearless of thwart or limit.

In proof that with improvements criticism becomes more keen and demands more imperative, we have only to look about us for promising fields to engage the inventor.

While the harvest of golden grain no longer falls before the classic sickle, and the haymaker has ceased to be a picturesque inspiration for the poet, the root crops still demand laborious delving and grubbing, and the ripened fruits still call for human pickers to pluck them one by one. For the inventor who would devise a mode of removing half the blossoms from a peach tree without injuring the buds which form the next year's bearing stems, there awaits a magnificent

prize. Ramié, and other fibers, still defy the textile art; and the gorgeous aniline dyes fade with a summer's sun.

Household fires, once synonyms of health and cheerfulness, are now the gloomy and noxious evidences of our heedlessness of things sanitary. Those domestic conveniences which should minister to our comfort and well-being, poison us insidiously but none the less surely. Our vaunted gaslights blacken our paint, kill our window plants, and destroy our shade trees. Our sewers and drains are confounded in name and function, and both of them are poisonous. Our chimneys breathe forth smoke, which is unconsumed fuel, and hence wasteful. Our steam boilers, with partly consumed fuel, supply our engines with wet steam, and the engines (whose cylinders have to be supplied with oil through faulty design and workmanship) waste part of the remainder. Our horses, shod with no regard for humanity or for tractive effect, draw wagons or cars which rattle our teeth out, on roads or rails which rattle the vehicles to pieces. The explosives, which long ago were constrained to throw hurtful missiles for miles, have only in one instance—blasting—been employed in peaceful work, if we may except the gunpowder pile driver, the precursor perhaps of a long line of explosive motors yet to come.

There is yet no ice machine which will satisfactorily and economically compete with nature in supplying a commodity that has now become a necessity. The science of aeronautics, to which the veteran Wise gave his life, and others nearly as well known have devoted so much time and skill, has not yet been developed from flotation to guidance, still less to propulsion. A spark of fire has terrors greater far than the avalanche or the glacier.

For these, and hundreds of other evils, inventive genius must provide the remedy; and as new and artificial wants arise and develop into necessities, upon the inventor, ever in the vanguard, devolves the duty of exploring the land of the possible and providing for the legions of the actual.

It might be said that as science after science falls into the ranks of knowledge, and art after art is added to the forces of man, the field of true invention would narrow, and that of improvement, combination and application correspondingly widen. And this distinction may not perhaps be improper to draw nor inappropriate to apply. Certain it is, that as observation and experience lay down the facts, and reason deduces therefrom the theories, and evolves from these again the laws which govern things tangible and forces intangible, the plane of the inventor will rise higher. It is to him that races unborn, nations unformed, and countries unexplored look for their betterment and the achievement of their substantial welfare. Through him the antagonism between man and man—the foul distinctions of caste and class—will be swept away, and better men of better lives, and higher pleasures and comforts, achieve the destiny written for them in the days when the rocky ribs of the earth were formed.

The American Workingman.

Dr. Lyon Playfair, one of the most prominent of English men of science, and a member of Parliament, who has lately returned to his native country from a tour in the United States, has published some of the results of his observations of men and things in this country, which convey some very instructive and suggestive statements bearing upon the industrial future of the United States. Coming as they do from a representative Englishman, of large views, thoroughly competent by reason of his intimate familiarity with the industries of his own country, and favored with every facility for obtaining accurate information, Mr. Playfair's opinions are of special interest.

Mr. Playfair publishes in a recent number of *Macmillan's Magazine*, a paper entitled "Industries of the United States in Relation to the Tariff," in which we find some material for future consideration, and some comments on the position of the workingman in the manufacturing States, which last specially interests us here. We shall give, therefore, in the following a brief summary of the author's impressions on this subject.

Mr. Playfair states that the true American mechanic, by descent, education and training, is excellently adapted to his work. His chief center is in New England, though he is rapidly spreading everywhere. The original settlers in New England were men of strong will, and above the average of the old country in education and enterprise. Their early love for education is shown in the fact that soon after their settlement, they established Harvard College. These men landed on a rough, inhospitable coast, covered with wood, and they had few tools with which to conquer nature. They were obliged to be men of many resources. In possession perhaps of a single tool, they turned it to many purposes, and if did not suit, they altered it. This reliance, inventiveness and industrial application developed together.

The soil of the New England States is the poorest for agricultural purposes, while the climate is not sufficiently changeable for a large variety of crops. The rocky and poor soil upon which the early settlers landed, forced the increasing population into manufactures and commerce, so that they acquired habits of industry and thrift. As they gradually extended westwards and southwards, better climate, land and raw material opened up new sources of wealth, and the qualities acquired by the first colonists enabled their descendants to take advantage of improved conditions.

The New Englanders never forgot that their superior education had been of powerful assistance to them as early settlers, and they kept up knowledge among their descendants. It is a rule among Americans that the schoolhouse must precede the factory, and that capital applied to industry without knowledge is worthless.

Even the Puritan sense of religion, Mr. Playfair believes, has had great effect on manufactures. The commandment, "Thou shalt not steal," is carried out in manufactures. When cotton goods are sold, the material is wholly cotton, and is not weighted with China clay or sulphate of baryta. The 600,000 muskets sent out to Turkey during the war, were made to shoot and not to sell.

American goods, he affirms, are dear, but they are true and good. The example of New England spreads over the Union, and has produced an honest and efficient workman everywhere. The high price of labor gave a great stimulus to the invention of labor-saving machinery, while the patent laws wisely encouraged inventions.

Thus, the true American Mechanic is generally superior to, though not dearer, than the mechanics who enter by immigration. He is too dear for inferior work. But even in the case of imported labor, American industry has a great advantage over other countries. The emigrant arrives in the full power of production, while the country which sent him forth had to pay for his childhood, during the years in which he possessed no productive value.

Lawson's Theory of Steam Boiler Explosions.

We print on another page of this issue an interesting communication describing the experiments lately made by Mr. D. T. Lawson, of Wellsville, Ohio, to demonstrate the correctness of his theory that steam boilers explode by the sudden abstraction of a considerable volume of steam, which, by relieving the superheated water in the boiler of pressure, causes it to instantly burst into steam, which, meeting with the sudden check offered by the resistance of the confining shell of the boiler, produces a concussive effect upon every square inch of the boiler much greater than the regular pressure of the steam, and frequently sufficient to cause it to explode with violence.

Those who have read Mr. Lawson's article, and our earlier references to his experiments, must have satisfied themselves that he has succeeded in making out a very strong case in favor of the reality of the source of danger that he deals with. The violent explosion of several steam boilers at pressures far below those which they had previously withstood without injury, by simply providing means for the sudden removal of a quantity of steam from the steam space, which Mr. Lawson succeeded in doing, affords proof amounting to demonstration that his estimate of the real danger from this cause is not a fanciful one. The general principles underlying this theory have long been known, and the theory itself has been broached and discussed by mechanical engineers; but it remained for Mr. Lawson to formulate it into a definite proposition, and to demonstrate its correctness by experimental proof of the most convincing character. For his services in this direction, Mr. Lawson has laid the mechanical fraternity under heavy obligations, and he deserves the fullest credit and recognition as one who has materially added to our knowledge. This, we doubt not, all will cheerfully accord to him, as we do.

With the natural enthusiasm, however, of one whose mind is occupied with a new discovery, Mr. Lawson is disposed to attach, we think, too much importance to it, for the careful reader will draw the inference from his article that he refers all explosions of steam boilers to this cause. On this point, Mr. Lawson falls into, what, under the circumstances, is an excusable error.

Mr. Lawson has demonstrated beyond question that a boiler may explode with violence with a full supply of water, but his demonstration does not affect the validity of other causes of explosion, which are equally well demonstrated.

His experimental device for suddenly relieving pressure from his boiler, though it considerably exaggerates the conditions which exist in practice, shows to those who read the experiments rightly, the danger of suddenly opening wide a throttle valve after a period of rest, when the pressure in the boiler has been permitted to approach the limit of safe working pressure, or to exceed it.

How considerably the conditions of ordinarily prudent practice in the use of steam boilers were exaggerated, will appear from a careful reading of the details of Mr. Lawson's experiments. From these, it appears that the area of the opening from which the steam was suddenly withdrawn was approximately one-200ths of the entire surface area of the water. The manner of withdrawing the steam by means of the gate valve employed, again practically effected the sudden enlargement of the steam chamber of the the boiler about one-10th of its capacity. In spite of exaggerations, however, which Mr. Lawson found necessary in order to render the experimental demonstration of his theory unmistakable, it would be a grave mistake to ignore their important bearing upon steam boiler practice, for where the circumstances combine to form the conditions above stated, the elements of danger called into existence are very analogous to those of Mr. Lawson's experiments.

Mr. Lawson's preventive, an arched perforated diaphragm, fixed horizontally in the boiler near the water line, supplied with valves under the control of the engineer, and having for its object to retard the time of the passage of steam from the water compartment into the steam compartment, and thus to prevent the instantaneous removal of pressure from the water, is worthy of careful examination by steam engineers. That it is rational in theory, and proved efficacious in the trial tests to which it was subjected, seems to be unquestionable.

We take particular interest in inviting the careful consideration of our mechanical readers to these highly important and suggestive facts and experiments, and shall be pleased to have them discuss the subject in all its bearings in our columns.

The Westinghouse Engine.

We illustrate and describe in the following a high-speed engine of improved construction, which embodies some quite original features, and which is offered by its makers as a representative engine in all that is essential to a perfect steam motor. While the primary objective point of the designers and constructors of this engine was high speed, they affirm that they have sacrificed nothing in respect to economy of fuel, durability, cool and noiseless running, etc., to gain this point, in proof of which they invite attention to the following principles which they have recognized in its design and construction: The steam ports are very direct and large, having an area of 7 per cent of that of the piston. The engine has large exhaust openings, to avoid back pressure. This feature is secured by the adoption of an annular exhaust, which is 13 per cent of the piston area, without involving any enlargement of the steam ports, and consequent increase of valve travel and clearance. As the accurate balance of the reciprocating parts is one of the necessary conditions of high speed, the makers of this engine have endeavored in their design and construction to secure this condition as perfectly as possible. To this end, the reciprocating parts of each cylinder are exact duplicates of each other as to weight and extent of motion. The two cranks being opposite each other, instead of quartering, all the masses of each side are at all times moving in exactly opposite directions and with equal velocities. Hench, each precisely counteracts the effect of the other, whatsoever the speed. The balance is attained without complexity or multiplication of parts, and involves no stuffing boxes, inaccessible pistons, etc. The fact that the two pistons work side by side, and not in the same plane, leaves a slight unbalanced effect in a direction parallel to the shaft only, which is adequately provided for in the length of base.

In evidence of their success in satisfactorily meeting this condition, the makers state the fact that they are accustomed to mount these engines on spring trucks for portable electric lighting, pumping, etc., and that under these delicate conditions they run at a speed of from 1,000 to 1,100 revolutions per minute without perceptible vibration. The balance of the rotating parts, is in part accomplished in the balancing of the reciprocating parts, and is further perfected by "balance bobs" on the cranks and eccentrics.

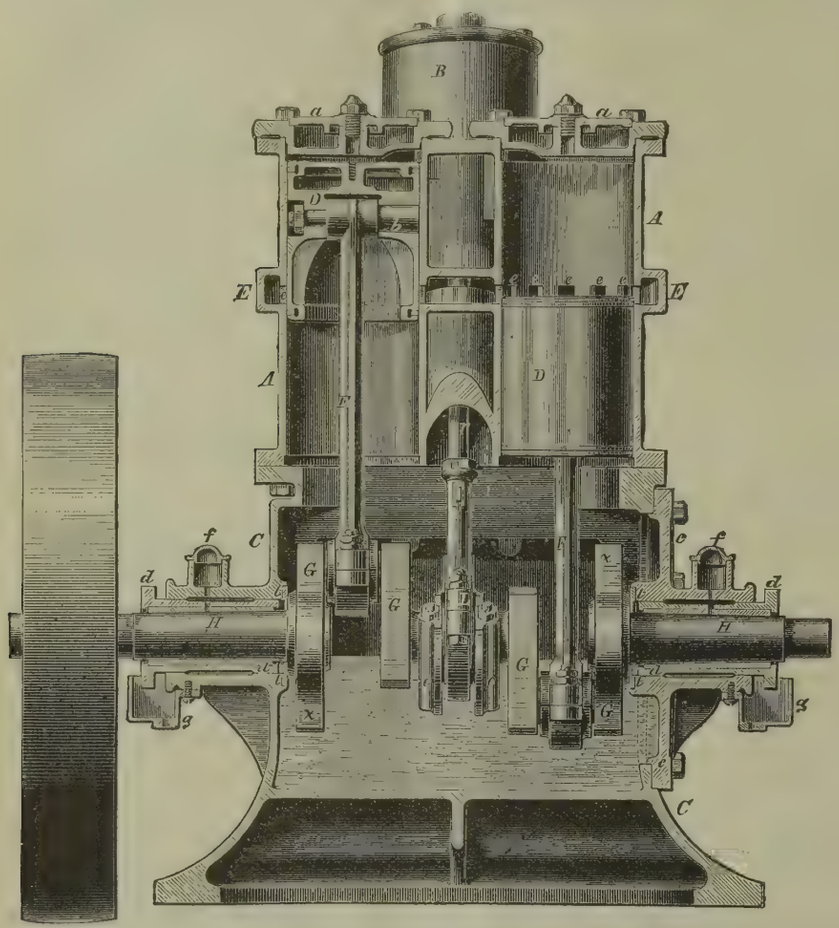


Fig. 1.—Vertical Section Through Shaft and Cylinders.

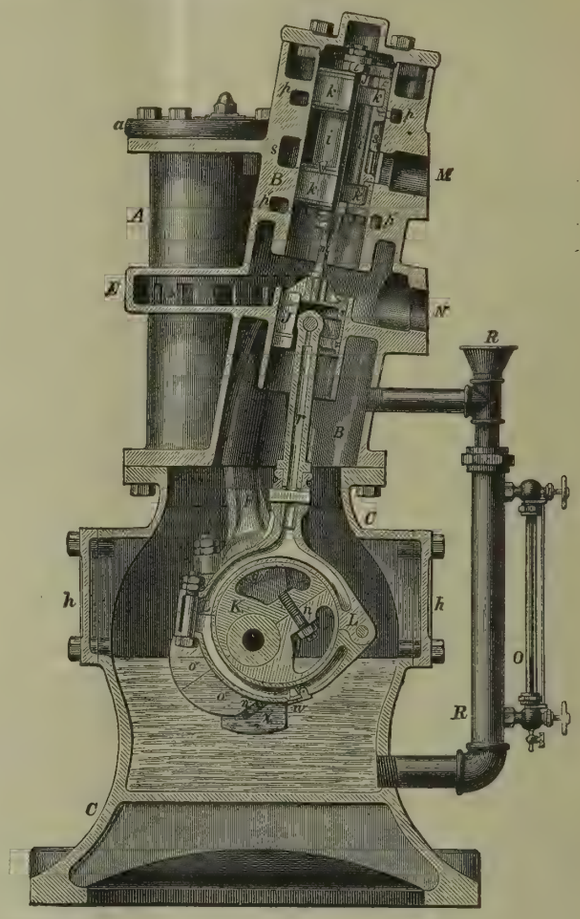


Fig. 2.—Vertical Cross Section Through Valve and Valve Gear.

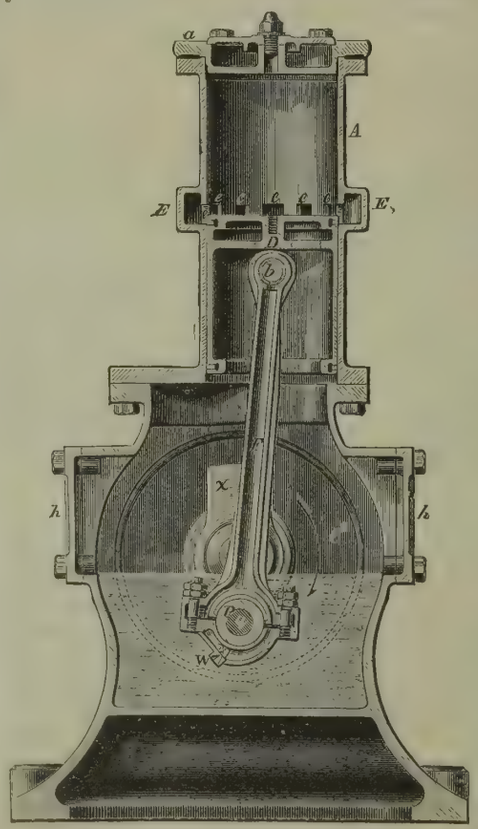


Fig. 3.—Vertical Cross Section Through one of the Cylinders.

The pistons are hollow, to insure lightness of the reciprocating parts; and this is further sought to be attained by making the connecting rods, valve gear, etc., hollow, so as to secure the maximum of strength with the minimum of weight.

The makers of the Westinghouse engine lay much stress upon another feature of their design, for securing constant direction of strains. It is well understood that with the ordinary forms of double-acting engines the direction and nature of all the strains are changed twice in each revolution from compression to extension, and *vice versa*, as the steam is alternately admitted to each side of the piston. Hence the necessity for elaborate means for taking up lost motion at every joint, and hence also the still more pressing necessity for an engineer competent to so make the adjustments as to avoid heating on the one hand and pounding on the other. With the single-acting cylinder, on the other hand, all parts are subjected at all times to compression only; hence, no matter how much lost motion exists, it is always taken up by the pressure of the steam acting constantly in one direction. The weight of the parts also acts with the steam pressure to assist the same result, unlike some other single-acting engines, in which, the cylinders not being vertical, the weight acts to draw the joints apart. Indeed, the makers affirm, it is quite possible to run one of these engines with the lower half of the crank-pin box removed. A like result is secured in the valve motion, which, though double acting, is kept closed as to lost motion by the slight pressure of the exhaust steam acting upon the upper side of the valve guide. The practical results claimed by the makers, are: First, absolute freedom from pounding or noise of any sort up to speeds of 1,200 revolutions per minute; and second, the practicability of continuous running.

These engines are provided, furthermore, with bearings exceptionally large. The manner in which lubrication is effected is at once novel and effective. The valves and pistons are lubricated in the usual way by an oil pump discharging into the steam pipe.

All the other running bearings are contained within the enclosed chamber of the crank case. The case is filled, as shown in the sectional views, to near the bottom of the shaft with water, on which is floated a certain quantity of oil. Into this the crank and eccentric dip at every revolution, and it may readily be believed that when running to speed the entire chamber of the crank case and cylinders is filled with a foam of oil and water, which is bound to reach every part. In the smaller engines this foam is found adequate to properly oil the wrist pin in the piston. In the larger engines an additional device is employed (shown in Fig. 3). The connecting rod is of malleable iron cast hollow, as is also the lower half of the crank-pin box. In this is a little brass valve W, opening inwards. At each revolution oil is forced into the hollow rod, and being prevented by the valve from returning, it is thus pumped, as it were, on to the wrist pin *b* through the oil hole shown. A similar valve *w* is fitted to the eccentric strap. Moreover, ample lubrication is provided for the main bearings by the oil which finds its way out past them. Any excess is caught in the drip cups *g g*, and the grease boxes *f f* (Fig. 1) are generally found to be superfluous. A glass gauge O is attached to the crank case, whereby the level of the oil within may be seen. Usually, the makers, explain, the increase of water by condensation about supplies the waste, though it may sometimes be necessary to add a little water through the tube P. This novel method of lubrication is claimed to be at once thoroughly effective, cleanly and economical; and so well assured of its efficiency are the makers, that they make the unqualified statement that a hot pin or bearing on their engine is impossible.

In their design, the makers have proceeded on the theory that a high-speed engine should be self-contained and possess sufficient rigidity to be independent of any settlement of foundations. They generally furnish two fly-wheels, one on each side, either one of which, or both, may be belted from. While a foundation is always desirable, these engines may be run with entire success on the floor of a building or on a truck, as stated. Their perfection of balance in connection with this feature adapts them to use on the upper floors of elevated buildings, where they may be relied upon to run without tremor or vibration.

Of our illustrations, Fig. 1 is a vertical section through the shaft and cylinders, Fig. 2 a vertical cross-section through the valve and valve gear, and Fig. 3 a vertical cross-section through one of the cylinders.

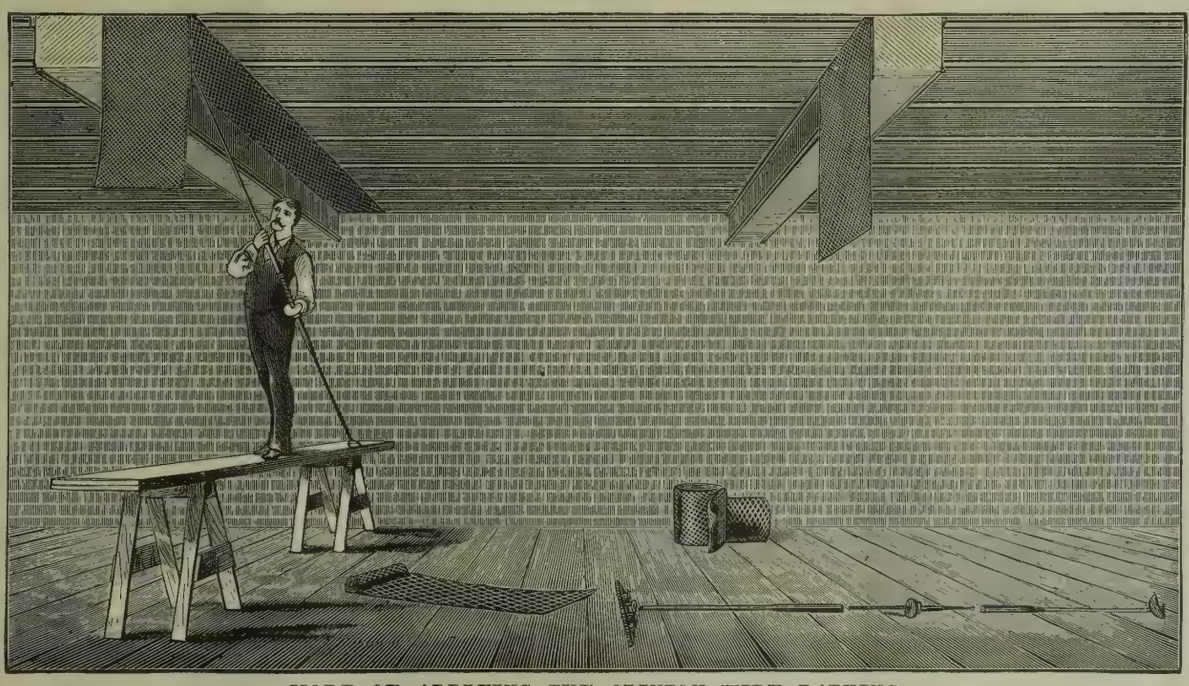
The makers, in constructing this engine, have borne in mind that, for the service demanded of the modern steam engine, the highest grade of workmanship and the best materials are indispensable. The attention bestowed upon the mechanical details has led also to complete interchangeability of parts, which extends to every detail of the engine, any portion of which can be supplied to the user of the engine.

The makers further claim that their engine will be found peculiarly adapted to electric lighting of all kinds, circular-saw mills, rolling mills, grain elevators, fan blowers, rotary or centrifugal pumps, paper mills, print works, mining, light manufacturing where the engine may have to be located on upper floors; to portable power, as where pumps, electric lights, etc., must be mounted on trucks; to relay powers auxiliary to deficient water power; to steam yachts and tugs, where they are fitted with a simple reversing gear; and to all purposes where power is required and where low first cost, simplicity, durability and economy are an object.

For additional facts and details concerning this admirable engine, which want of space compels us to omit, we refer our readers to the manufacturers, the Westinghouse Machine Company, 92 and 94 Liberty street, New York.

Wire Cloth and its Uses.

In view of the special interest excited among architects and others during the recent exhibition season in Boston, by the important nature of the display of products made by the Clinton Wire Cloth Company, we have considered it to be a matter of sufficient interest to give our readers a somewhat detailed account of this establishment, its products, and the manner of using them.



MODE OF APPLYING THE CLINTON WIRE LATHING.

The Clinton wire-weaving establishment, the largest works of the kind in the world, is located at Clinton, Mass. The works cover an area of some six acres, one of the buildings being over 200 feet high, giving them quite an imposing appearance.

The industry represented by the Clinton Wire Cloth Co. originated with Mr. E. B. Bigelow, the inventor of the carpet loom, who conceived the practical notion of weaving wire by power looms. His experiments in this direction were begun early in the fifties, and speedily resulted in establishing a new industry. The Clinton Wire Cloth Company was incorporated in 1856, a large mill was erected, and the enterprise was entrusted to the management of Mr. C. H. Waters, a gentleman thoroughly familiar with weaving machinery.

To weave wire on a power loom with sufficient rapidity to make it commercially successful, presented numerous difficulties, which were only overcome by dint of unrestricted expenditure of money, by patience, and persistence. Happily these difficulties were one by one overcome, and to-day the company has six mills in operation, weaving every kind of wire cloth known to the trade, from the finest gossamer web, to cloth made from wire so heavy that each wire will bear a weight of 3,000 pounds. The accompanying description of the products of the company will be read with interest.

The Clinton window screen cloth is a product that has come into universal use throughout the country. It is woven of fine wire, painted either green, black, drab, and figured and landscape patterns, and comes into the market in rolls of 100 lineal feet in length and from 24 to 48 inches in width. The annual product of screen cloth turned out by the company reaches the enormous total of 30,000,000 square feet.

The Clinton fire-proof wire lath is a product that is of special interest, and is coming into very general use as its merits are becoming appreciated. It consists of iron wire woven about a quarter inch mesh, and is specially intended to be used for plastering on, in place of the wood lath commonly used for the purpose in construction. At the close of the late fair season in Boston, several very important experiments were made by a committee, appointed for the purpose, in order to test a number of fire-proof materials entering into the construction of buildings. These experiments were referred to at the time in our columns, and the results obtained were deemed so useful that the Boston Society of Architects determined to repeat them on a larger and more satisfactory scale. Among the materials which were tested in these experiments was the Clinton wire lathing, which made an admirable record under very trying conditions, and the commission having the experiments in charge, expressed the most favorable opinion concerning the value of this product as an effective fire proofing material for construction purposes.

As all thoughtful persons are aware, in the currently practiced mode of house construction where wood lath is used, this is the most dangerous element of the building in causing the spread of a fire. The substitution of wire in lieu of wood for this purpose is a great step in advance in rendering the building fire-proof. The wire lath holds the plaster without cracking in situations where wood lath entirely fails. The plaster cannot become detached from the wire lath, for the reason that when applied it clinches on both sides of the wire, thus forming a double surface of plaster. Successive layers of plaster may therefore be applied without fear of cracking the underlying layers. It requires no special skill for putting in place, and can be readily applied to iron beams and brick arches. It is affirmed, further, that it will not corrode, and strong evidence is adduced to establish this important point. As to its cost, the company explain that its use will add from one-tenth to one per cent to the first cost of a building, as compared with wood lath.

In addition to this standard method of employment, the advantages of which are too obvious to require

further comment, the wire lath is recommended for the surroundings of furnaces and hot-air pipes, to protect stairs of either iron, wood or stone, to protect iron and wooden columns, and for finishing upon brick walls.

For applying the wire lathing, the following, instructions are given: For the covering of ceilings where wood floor joists are used, apply furring strips 1 x 1½ inches, placed 6, 12 or 18 inches apart, according to the quality of the job desired, fastening the lath by driving staples 6 inches apart. For the covering of ceilings and timbers of mills and warehouses having plank floors, nail furrings of wood ¼ x 1 inch, to planks and timbers, 6, 9 or 12 inches apart, as shown in our illustration. It will be noted that the thickness of the furring strips may be made to determine the thickness of the mortar above the lath, and the thickness may be made to meet the demands of any case, as mortar can be easily forced through this lath to any desired thickness. After such furring is placed—being well nailed—cut the lath into such lengths as will reach from side to side of the room, allowing three inches, more or less, to lap down upon each side of the room, to be nailed to the walls. Apply the stretcher by inserting the serrated jaw into the meshes of the lath at such point as will allow it to strain to the opposite side. Set the stretcher at an angle of 45° with the ceiling, and with the screw distend the jaw until the lath is made perfectly straight and taut. When fully distended, nail firmly behind the jaw, when the stretcher itself may be removed.

After covering the ceiling, cut the lath into strips of such length as will wrap around the timbers (as shown in the engraving), and lap one or two inches upon the ceiling on either side. This method will be found more convenient and expeditious than that of covering the timbers lengthwise. At all points where two pieces of lath come together, one sheet should be lapped over the other ¼ inch, and nailings made through both sheets. This will prevent any tendency to crack at such points.

With each lot of lath to be applied to wood, a sufficient amount of wire staples is furnished for the job, usually amounting to seven staples per square foot. In the use of staples, in all cases set them in the corner of the mesh, in order that they may cover the cross wires. If one-half the staples that are sent are properly applied, the lath will safely carry 400 pounds per superficial foot. The method of applying the wire lathing is shown in the engraving.

There is sometimes experienced a difficulty in applying plaster on wire lath made on hand looms, because of its irregularity; from this difficulty the power-loom woven wire is entirly free. The great utility of this application of wire cloth is too apparent to require argument, and its use is worthy of the particular attention of our architects.

In the production of locomotive-sparker cloth, the product of the Clinton company is specially well adapted. The difficulty experienced in the use of the hand-woven material, is due to the fact that the force exerted was not sufficient to take the stretch out of the wire, and to drive the filling up to make firm cloth. To meet this emergency the company caused to be constructed for the manufacture of this product, a loom weighing over 30 tons, upon which the wire is subjected to a strain of 25 tons, the resulting product being a cloth so firm that the exhaust of the locomotive has no effect in causing the wires to cut each other as they do in loose woven cloth.

Last month a new loom for the special work for weaving sparker cloth was finished for the company, in which No. 4 wire is woven with the ease of a hand loom weaving No. 30.

Of the miscellaneous products of the company, may be named all kinds of hexagonal nettings, steel, brass, copper and galvanized wire cloth.

Another special application of the woven wire is of interest—namely, in the construction of malt kiln floors. In this connection, the wire is found to answer admirably. The cloth is woven of heavy wire in a peculiar manner, and is then rolled under a train of rolls until it is as smooth as glass. Its advantages in a malt kiln are represented to be that it presents a vastly greater number of openings for the heated air to enter and pass through the malt than by the use of perforated plates, thus shortening the process of malting, and improving the quality of the malt.

The Clinton Wire Cloth Company has been the pioneer in many of the improvements pertaining to its branch of manufacture, and is under the charge of an enterprising and well-informed management. Since September the mills of the company have been running two sets of hands, working day and night.

The company's offices are at 13 Sears Building, Boston; 68 Beekman street, New York; 148 Lake street, Chicago; and general office and mills at Clinton, Mass.

Walker's Pocket Photographic Camera.

Amateur photography is a comparatively new and certainly most fascinating and useful occupation and pastime, and is rapidly becoming generally popular.

Walker's Pocket Photographic Camera.

The professional no longer occupies the wonderfully interesting field of photography undisputed. The march of progress has given us the "dry-plate process," by means of which, and with the use of proper apparatus, any one, without experience or previous knowledge of the art, may take fine photographic views of landscapes, buildings, drawings or other objects of interest. All inconvenience and uncertainty in the preparation of what are known as the old "wet" plates (which must be used as soon as prepared) is now done away with to make room for the permanently sensitized dry plate, which will retain its properties indefinitely, both before and after exposure on the view. This great innovation in the art of photography has stimulated a demand for a light, compact and accurate apparatus for the use of amateurs.

Mr. Walker, of the firm of Wm. H. Walker & Co., of Rochester, N. Y., at the Cincinnati Industrial Exposition, held last August, exhibited what is known as Walker's Pocket Camera, with complete photographic outfit for amateurs' use. The pocket camera answers every requirement for the amateur, is made of well-seasoned old cherry, with fine achromatic, wide-angle lens (giving remarkable depth of focus and flatness of field), nickel-plated mountings, adjustable tripod head, with folding legs, and a hard-rubber, double dry-plate holder. It is accurate and compact, weighing but two pounds; size of box outside, 4×4×5 inches, thereby requiring so little room as to be invaluable to tourists who cannot be burdened with cumbersome apparatus.

The accompanying engraving gives a view of this miniature but effective apparatus, representing it mounted ready for use, while the case below, in which it can be packed and swung over the shoulder, gives a good idea of its portability. A complete outfit consists of the camera as above, also the few and simple chemicals required for developing the plates, a ruby lamp, dark box, one dozen plates, sensitive paper on which to print the photograph, printing frame, card mounts, and an instruction book giving full directions as to details.

By the use of these cameras and outfits, any one, with a very little practice, is enabled to produce fine work. As before stated, the dry plates are capable of retaining the latent image after exposure, indefinitely, so that having become accustomed to judge the proper time a plate should be exposed in a given light, any number of plates may be exposed and packed away during a summer's trip, to be developed at some convenient time at home. The entire process is simple and interesting, and when once attempted, fascinates beyond description.

Architects, builders and draughtsmen will be reminded, in reading this, of the many ways in which such an instrument may be made useful in their professional work.

Mr. Walker has prepared a very interesting and instructive manual on the practice of dry-plate photography, with the taking title of "The Amateur Photographer," from which many additional details may be gleaned by those desirous of inquiring further into the subject. To all such we would suggest writing Messrs. W. H. Walker & Co., Rochester, N. Y.

The New England Manufacturers' and Mechanics' Institute Fair at Boston.

The managers of this energetic institution have already made preliminary arrangements for holding an exhibition this fall on a large scale, and hope to eclipse the excellent display of last year. While it will be of the same general character as the former one noticed in this journal, the coming fair, it is announced, will be more complete, and, profiting by their experience, the enterprise will be more perfect than it was possible to make the last. The exhibition building has been much improved by internal changes and by certain enlargements; the surroundings have been beautified, and the avenues of access much bettered. The exhibition this year will open Wednesday, September 6th and continue until November 1st. The reception of articles for exhibition will commence August 1st. We shall speak of the arrangements for this exhibition more fully in succeeding numbers. The applications for space are already more than double those received last year.

American Institute of Mining Engineers.

From the preliminary announcement of Dr. Drown, the Secretary, just received, we are informed that the next meeting of the Institute is designed to be held in Colorado, beginning in Denver on Monday, August 21, 1882. This meeting will afford the members a rare opportunity of personally seeing and examining many of the important mines and metallurgical works of Colorado, which are among the most important and interesting in the United States. A week or ten days will probably, according to announcement, be spent in the State. Detailed arrangements as to transportation rates, and the like, will shortly be made, and the members will be promptly advised of the same. It is expected, in view of the great professional interest which the locality of the meeting will have for the members of the Institute, and the opportunities of professional study and observation which it will afford them, that the meeting will be very largely attended and its sessions correspondingly important and interesting.

Some Recent Mechanical Improvements.

Figs. 1, 2 and 3 show views of an improvement in nail-feed attachments for nailing machines, with especial reference to such as are intended to be driven by steam power. This invention is stated to be an improvement upon a previous one, and has for its object to scatter the nails that are distributed by the feed wheel, so as to bring them separated into position on the guide troughs, whence they are moved to the lateral conveyer. The earlier machine of which this invention is designed to be an improvement, was open to the objection that at times the feed-wheel would throw the nails in clusters into the guide troughs, thereby interfering with the continuous operation of the machine. Another object of this improvement is to supply the feeding mechanism with a device for yielding to an interfering nail should one be caught between the feed-wheel and hopper; another is to provide a yielding resistance to the lateral conveyer in the event of a nail clogging the latter; and another is to so place the wiper which disengages the nails from the conveyer, as to prevent its action being interfered with by the more or less imperfect heads of the nails. In the present device the wiper takes hold of the body of the nail beneath the head, instead of taking hold of the head, as in the earlier machine.

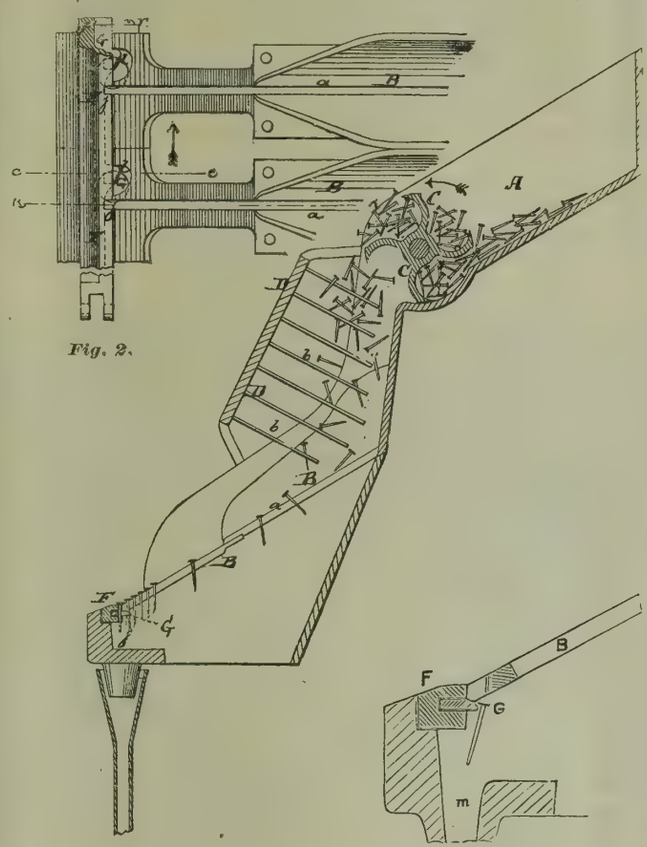


Fig. 2.

Fig. 1.

Fig. 3.

Fig. 1 is a vertical longitudinal section of the nail-feeding attachment; Fig. 2 a plan or top view of a portion of the same; and Fig. 3 a detail vertical section taken on the plane of the line *c c*, Fig. 2. In these A represents the hopper, placed in inclined position on the frame of a suitable nail-boxing machine. The hopper is open below, and communicates with the guide troughs B B, each of which has a slot *a* in its bottom. In the lower part of the hopper A is the feed-wheel C, which takes the nails from the hopper A and throws them into the guide troughs B. The scatterer D, which is one of the important features of the invention, consists of a plate, bored or lattice frame secured on suitable standards above the feed troughs and in front of the feed-wheel. It is provided with projecting pins or rods *b* of wire, the object of which is to scatter and separate the nails that are thrown by the feed-wheel, thus preventing them from reaching the feed troughs in bunches, and thus interfere with the action of the machine. Another feature of the invention is a spring connection (not shown in the cuts), which arrests the motion of the feed-wheel if a nail should be caught between it and the lower part of the hopper, without arresting the motive power or breaking the parts. G, Figs. 2 and 3, represents the wiper, and B the feed throughs or channels, between which and the hopper the scatterer is operated as above described. This improvement is patented by F. Rochow, of Brooklyn, N. Y.

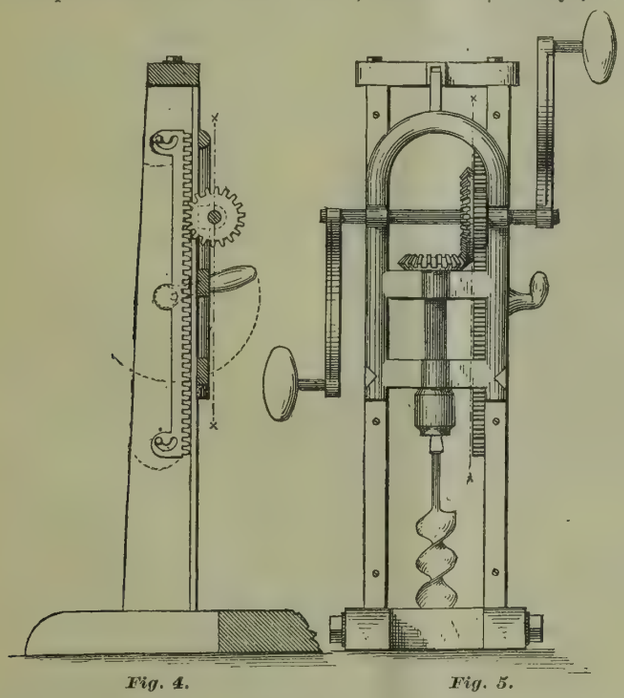


Fig. 4.

Fig. 5.

Figs. 4 and 5 illustrate certain ingenious improvements in the construction of wood-boring machines, devised and patented by William E. Lawrence, of New York city. The invention refers specially to that class of wood-boring machines in which an auger is carried by a traveling frame, and the latter is raised by means of a rack gearing with a pinion on the driving shaft, and has for its object to simplify the construction and increase the efficiency of the machine. Fig. 4 is a sectional elevation, and Fig. 5 a front elevation, of a boring machine with these improvements. The base, side pieces, sliding frame, boring bar and driving shaft, both turning in bearings of said frame, and the bevel gears on the bar and shaft, are all similar to those in ordinary machines of this kind. Upon the shaft is fixed a toothed pinion, and on the inside of the side piece, opposite the pinion, is arranged a rack bar, having at the back edge three lugs, the center lug being perforated to receive an eccentric pin upon a cylinder turning in a hole in the side piece, and provided at the outer end with a crank handle, whereby it may be turned so as to carry the bar to or from the pinion.

The motion imparted to the rock bar being a curve, the guide slots in the lugs are also curved, and receive the stationary pins seen in Fig. 5 projecting from the side piece. By this construction the bar is locked in whichever position it is adjusted. Thus, when turned to the position shown in Fig. 5, its teeth engage with those of the pinion, and the boring bar frame is raised by turning the driving shaft, and the pressure upon the bar in any direction cannot force it back and away from contact with the pinion, owing to the peculiar form of the lock slots. By a single movement of the hand the handle may be turned to the position shown in dotted lines, when the bar will be carried away from the pinion, and will be locked securely in this position until the handle is again swung forward. It will be seen that when the bar is carried back, it is so far removed at all points from the pinion that it cannot engage therewith until the rock cylinder is again turned.

The device shown in Fig. 6 represents an improvement in lathes for turning irregular forms, especially for turning boot and shoe lasts, and is patented by Wm. S. Huntington, of Brookline, Mass.

The special object of the invention is to afford greater facility for cutting a last the reverse of the pattern employed than exists in ordinary lathes employed for turning lasts. The improvement consists in the combination of a shaft or spindle comprising two sections for carrying a pattern, and two other sections in line therewith for carrying the work, and providing means by which the sections carrying the pattern and those carrying the work may be locked together, so that they will all rotate together; and gear wheels which may be engaged when these sections are unlocked, so that those carrying the work shall rotate reversely to those carrying the pattern, by which a last corresponding to the pattern, or a reverse of the pattern, may be produced at pleasure.

From the foregoing description of the objects of the improvement, the inventor's claims, given below, will be intelligible without a detailed mechanical description, reference being had in the same to the figure. He claims the combination in a lathe of a shaft or spindle comprising sections J J′ for carrying a pattern, and sections J^2 J^3, in line therewith, for carrying the work, means for locking the sections J′ J^2 together, so that all the sections will rotate together, and gear wheels which may be engaged when the sections J′ J^2 are unlocked from each other, to

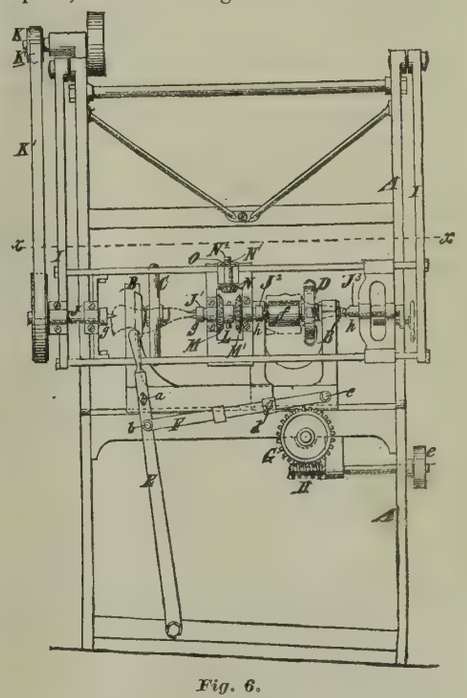


Fig. 6.

cause the sections J J′ to rotate reversely to the sections J^2 J^2; furthermore, the combination in a lathe of a shaft or spindle for supporting a pattern and the material to be turned, comprising sections J′ and J^2, the pin L, the bevel gear wheels M M′, the pinion N, and its adjustable shaft N′; and finally, the combination in a lathe of a shaft or spindle for supporting a pattern and the material to be turned, comprising sections J′ J^2, the pin L, the bevel gear wheels M M′, the pinion N, the shaft N′, the screw N^2, and the lever O.

Building Intelligence.

Architects, Builders and Contractors are invited to send us items of interest for this department. It is our object to notice only the more important operations in building, our space being too limited for the publication of minor matters, which, besides, possess only local interest. We wish to publish only such intelligence as is of general interest.

New York City Building Items.

A Methodist Episcopal Church is to be built at Madison avenue and Sixtieth street. It is to be of brown stone and will cost $125,000.

Charles Baxter is to draw plans for four first-class five-story brown stone flats, to be erected on the north side of Seventy-second street, between First and Second avenues, by Charles Sedgwick. Two of these flats will be 30 by 75 feet, and the other two 20 by 75 feet, each. The cost of this improvement will approximate $100,000.

Plans have been filed for the erection of new buildings for the following engine companies. At No. 166 Cedar street, for Engine Company, No. 6 to cost $13,000; at No. 15 Great Jones street, for Engine Company, No. 33, to cost $20,000; and at No. 8 Stone street, for Engine Company, No. 10 to cost $14,000,

Charles Baxter is at work on the plans for two extensive apartment houses to be erected on One-hundred and Thirty-second and One hundred and Thirty-third streets, between Fifth and Sixth avenues. They will be 32 by 70 feet, five stories high and built of brick and brown stone. The owner is James Whalen. They are to cost $25,000 each.

Plans have been filed for the erection of a new market on the site of the present Jefferson market. It is to be 122 feet front on Greenwich avenue, 47 feet on Christopher street, 82 feet front on Sixth avenue, and 99 feet deep. The building will have two stories and an attic, the front is to be of brick, and the cost will be $60,000.

O. B. Potter is clearing away the ruins of the burned building at Beekman street and Park Row, preparatory to the erection of a new building. It will be ten stories in hight and of brick. It will have three iron elevators, and even the window casings will be of iron. The cost will be about $750,000. It is expected to be finished in one year. The ground floor will be devoted to stores, and the rest to offices.

H. J. Hardenbergh is designing for the William Rhinelander Stewart estate a block of stores with flats above, to be built in Second avenue, between Eighty-sixth and Eighty-seventh streets. The material will be brick with stone trimmings, ornate in design. The excavations have been begun and the stores and flats are to be ready for occupancy next spring.

Opposite the Dakota, in Seventy-third street, between Ninth and Tenth avenues, Edward Clark is about to put up a row of twenty-eight dwellings, of which H. J. Hardenbergh is the architect. They are of brick and light colored sandstone, four stories in hight, ranging from 20 to 22½ feet in width, and with a uniform depth of 60 feet. The excavations are just being completed, and the houses are be to ready for occupancy in May, 1883.

The Albert is a handsome new apartment house, which is being built by H. J. Hardenbergh, at Eleventh street and University Place, adjoining the St. Stephens Hotel, for A. S. Rosenbaum, proprietor of the St. Stephens. The Albert has seven stories and an attic, is built of red brick, with sandstone trimmings elaborately carved. The woodwork of the interior is of walnut, harmonizing in design and treatment with the exterior. The building will soon be finished, and contains twenty-four sets of rooms for families, and thirty-four for bachelors.

Doubtless the most picturesque private residence in New York, when completed, will be that of Charles L. Tiffany, at the northwest corner of Madison avenue, and Seventy-second street, It will be noticeable alike for its size, for the fact that it embodies an idea, for its total dissimilarity to any other house in the metropolis, as it is the first example of its peculiar type of architecture in this city, and for its bold and somewhat aggressive individuality. To give the details of construction conveys no idea of the building; but its ground plan is 100 by 125 feet, it will be four stories in hight, with an attic, fireproof, and of blue stone. It will have a peaked roof, the highest point 113 feet from the sidewalk, and the greatest hight of main walls 90 feet. The architects are McKim, Meade & White, and the estimated cost is in the neighborhood of $200,000. The first two floors will be occupied by the owner, the third by Mr. Tiffany's daughter and the peaked roof will be used by Louis C. Tiffany for his studio and other rooms. The entrance will be reached through an arched court, and from this court to the unconventional and broken sky-line, the whole building will be a mediæval poem done in stone. It is to be such a structure as one finds in Amsterdam or Antwerp, and such as the citizen of the New World crosses the ocean to see. If there were such a thing as a Dutch Renaissance—which the authorities in architecture do not recognize, but which in reality does exist—this projected house of Mr. Tiffany's could be so described.

One of the most sightly locations in the city is the block in Eighth avenue, from Seventy-second street to Seventy-third street, facing the Park. It is here that the apartment house of Edward Clark, President of the Singer Sewing Machine Company, is being built. H. J. Hardenbergh is the architect, and John Banta the builder. The walls are already up to the sixth story, and the work is being rapidly pushed forward by a large force of men. The style is the Renaissance of of the period of Francis I., and the ornamentation is simple. The material is yellow brick and sandstone. When finished, there will be a basement, seven stories, and three additional stories in the peaked roof. The building incloses a large court, and the main entrance and driveway is in Seventy-second street, giving an unbroken window front looking on the Park. There are four main entrances at the corners of the court, leading to the elevators and stairways. The tradesmen's driveway reaches a court on the basement level, under the main court, and in the basement all work will go on unseen. The foundation walls are on solid rock, from 10 to 18 feet below the street level, and from 3 to 4 feet in thickness, of bluestone, laid in cement. There will be about fifty sets of rooms, with from five to twenty rooms in each; some are supplied with kitchens, and others have only dining-rooms, On the main floor, at the Eighth avenue, and Seventy-second street corner, is to be a large restaurant, including a dining hall and café, with private dining-rooms connected. In the basement will be the kitchens, engines, janitor's and storage rooms; in the attic, the laundries and rooms for servants. There will be seven hydraulic elevators, and the same number of stairways in iron and marble. The woodwork will be elaborately carved, but the scheme of interior decoration has not yet been fully decided on. Mr. Clark's apartment house has been named the Dakota, and eighteen months will be required for its completion.

Miscellaneous.

P. T. Barnum has decided, with his partners, James A. Baily and James L. Hutchinson, to build a large museum in this city as soon as a suitable site can be decided upon. A menagerie of wild beasts and a large theater will form a part of the enterprise.

William H. Vanderbilt purposes building a mausoleum on Staten Island, which will cover an acre and a half, and be 70 feet high. It will be possible to see it 20 miles at sea on a clear day. The sight is a large knoll, just outside the cemetery and facing the Moravian Church.

Increased Cost of Building a House.

It appears from careful calculations which have been made for us by leading architects and builders that the cost of building a house is from 10 to 15 per cent greater to-day than it was a year ago. That is to say, a domicile which would have necessitated an expediture of $20,000 to build in the spring of 1881 will require an outlay of $22,000 to $23,000 in 1882, and one which would cost $2,000 in 1881, will cost $2,200 to $2,300 in 1882.

The most marked advance this spring has been in the matter of labor. The following table shows the wages of skilled and unskilled workmen to-day and a year ago, with the percentage of advance :

	1882.	*1881.*	*Advance.*
Carpenters, per day...	$2 50	$2 00	25 per cent.
Bricklayers, face.....	3 25 @ 3 50	3 50 @ 3 25	8 "
" com.....	2 75 @ 3 00	2 50 @ 2 75	10 "
Stonemasons.....	3 00 @ 3 50	3 00 @ 3 50	None.
Hod carriers	1 75 @ 2 00	1 75 @ 2 00	None.
Plasterers' tenders....	2 00 @ 2 25	2 00 @ 2 25	None.

It will be seen that the wages of carpenters have risen in greater ratio this spring than those of other mechanics or laborers. This is due to the fact that activity in real estate has largely extended into the suburbs this spring, and an increased number of wooden houses are consequently being erected. The wages of stone masons were maintained on a full basis a year ago by a very strong union which exists among the journeymen in that trade. The wages of hod carriers and other unskilled laborers were also advanced earlier than those of carpenters. Our quotations of the present wages of the last-named artisans represent the average prices paid by leading builders. Some common "wood-butchers" are hired at $2.00 per day, while superior workmen receive as high as $3.00.

The following table shows the prices which builders are paying for leading classes of lumber, doors, windows, etc., now as compared with the corresponding date of 1881. These of course, are not wholesale rates, but are the prices which are paid for stock delivered at the place where it is to be used :

	1882.	*1881.*	*Advance.*
Pine, good finish..	53 00 @ 60 00	50 00 @ 55 00	6 @ 9 per cent.
Pine, com. shelving.....	38 00 @ 44 00	35 00 @ 40 00	8 @ 10 "
Spruce dimensions ₱ M.....	$17 00	$16 50	3 "
Spruce, upper floor, clear.....	30 00	28 00	7 "
Spruce, clapboards, extra.....	34 00	33 00	3 "
Spruce, laths.....	2 00	1 75	14 "
Doors, 2 ft. 8 in. x 6 ft. 8 in. and 1½ in. thick, No. 1..	2 50	2 30	8 "
Windows, 15x30 in. and 1½ in. thick, 4 lights of glass..	1 60	1 50	6⅔ "
Windows, 10x12 x 4½ 12 lights.....	1 12	1 05	6⅔ "
Blinds, 15x30, half roll, No. 1.....	90	80	12½ "
Blinds, 10x12, stationary, No. 2...	62	55	12½ "

It appears, therefore, that the advance in the various kinds of lumber has ranged from 3 to 12½ per cent since a year ago. Of course a comparison with the depressing quotations of the era previous to 1879 shows a much larger ratio of increase. The advance in windows this year will be seen to be about 6⅔ per cent, but the glass alone has risen about 10 per cent.

The comparative prices of bricks, lime and cement now and a year ago are as follows:

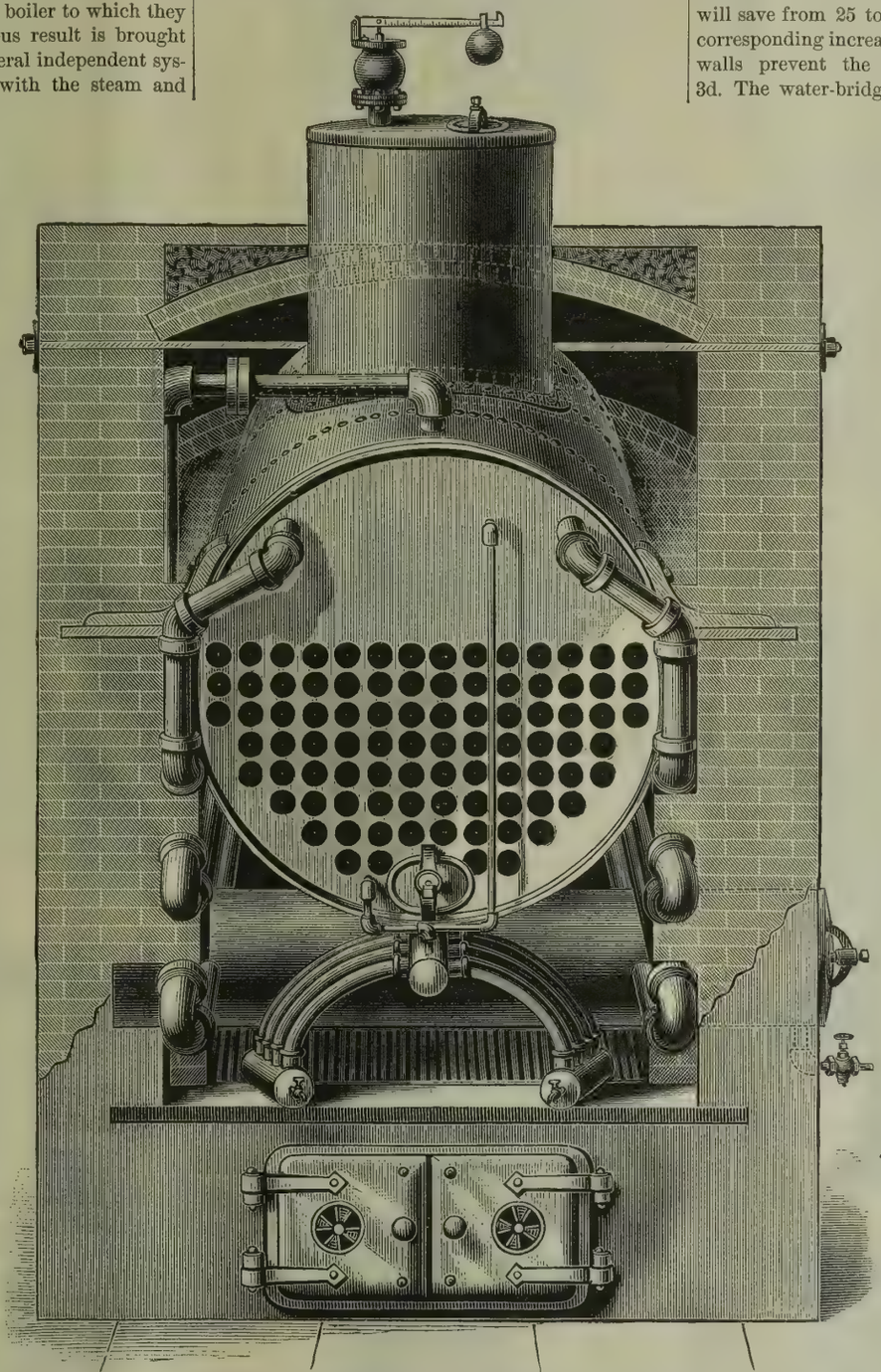
	1882.	*1881.*	*Advance.*
Bricks, com...	$10 00 @ 11 00	$9 50 @ 10 00	5 @ 10 per cent.
Bricks, Boston face.....	20 00 @ 21 00	17 00 @ 18 00	16 @ 17 "
Lime.....	1 15	85	35 "
Cement, Newark.....	1 50	1 30	15 "

Here are quotations of a few leading articles of hardware now and a year ago:

	1882.	*1881.*	*Advance.*
Nails, per keg.....	$3 50	$3 15	11 per cent.
Hinges, 3x3 loose butts, per doz.	88	80	10 "
Locks, iron face bolt, per doz....	2 12	1 83	17 "
Mineral knobs, common, per doz.	1 00	1 00	None.

Stead's Improvements in Steam Generators.

The improvements introduced by Mr. Stead in the setting of steam boilers, which we have had occasion to refer to in a former issue of this journal, are worthy of the special attention of steam users by reason of the excellent record the plan is making in practice. The results attained by Mr. Stead may be summed up in the statement that the devices which he employs effect a direct economy of fuel by materially increasing the steaming capacity of the boiler to which they are attached. This advantageous result is brought about by the employment of several independent systems of tubes communicating with the steam and water space of the generator, and surrounding the latter, in most cases, on the sides, front, rear and bottom. To understand the effect of these attachments, it will be useful to describe them more in detail. They will be understood by reference to the accompanying engraving, which represents a front view of a steam boiler with the Stead improvements attached. An inspection of this engraving discloses a drum beneath the boiler, which is intended to perform the double office of a mud collector and a bridge-wall, being located at the proper hight to leave an effective space between it and the boiler shell to produce the best heating effect. This drum is connected by suitable pipes with the steam and water space of the boiler. In addition to this, Mr. Stead employs several systems of heavy lap-welded tubes, forming several independent series of circulating pipes, which extend in a nearly continuous close coil along the sides, at the bottom in the rear of the water bridge-wall, at the rear and front of the boiler, the lateral circulating coils being supplemented in some cases by the addition of a circulating arch around the doors. In some cases a portion of this circulating system is dispensed with; in others, according to circumstances, the system is employed in full.



Front View of a Boiler with Stead's Circulating and Feed-Heating Attachments.

These attachments form a connected system of circulating pipes, by which the heating effect of the fuel is utilized to the utmost practicable limit. The feed-water enters the lateral circulating coils, and is obliged to make the circuit of the coils before entering the boiler through a distributing pipe in the steam space. The connections of these several systems of circulating coils are such that they can at no time be empty of water. A check valve provides against the direct entrance of the feed-water into the boiler; but so soon as the action of the feed pump ceases, the valve opens and admits the water from the boiler to enter the coil, thus maintaining the circulation. Where bottom feeding coils are employed, they are disposed so as to be slightly inclined, the water being fed into the lower side and passing as steam and water into the boiler from the elevated side. The drum is also slightly inclined, so as to cause the accumulation of sediment in the blow-out end, and, as above remarked, acts in the double capacity of a bridge-wall to fire against, and as a mud drum to receive and separate the sediment of the feed-water. By these several connected series of circulating coils and attachments, the heating surface of the boiler is largely increased and its steaming capacity largely augmented. The water in all parts of the boiler is kept in constant agitation by the rapid and efficient circulation maintained in the tubes, thus effecting a more rapid liberation of the steam, while the largely increased surface exposed to the action of the furnace gases insures a far more complete utilization of the heat of the furnace than it is possible to obtain in ordinary practice.

These attachments have been placed upon many hundred steam boilers since they were first introduced some years ago, and from all the testimony we have been able to glean, they have proved uniformly satisfactory, having shown themselves very durable in practice, remarkably successful in increasing steaming capacity, and effecting a marked saving in fuel. These advantages are shown to be genuine by the records of numerous tests that have come under our observation, and of which it will be unnecessary for us to say more in this place than to refer to the testimony offered by Prof. R. H. Thurston, a universally recognized authority in mechanical engineering, a record of whose tests of a steam boiler with the Stead attachments appears on page 221 of our issue for October, 1880.

In this connection, a brief re-statement of the inventor's claims may have some interest, and we append them herewith: "The following are a few of the facts and most important points to which the attention of the steam user is called: 1st. The generator will save from 25 to 50 per cent of fuel, or give a corresponding increase of power. 2d. The water side walls prevent the fire brick from burning out. 3d. The water-bridge wall does away with a brick bridge-wall. 4th. As the water has to change through the mud drum or bridge wall many times during the twenty-four hours, the mud and sediment fall to the lower end of the drum and are blown off from day to day, according to the state of the water. 5th. The automatic valve being placed between the system of pipes and boiler, no feed-water, hot or cold, can enter the boiler until it passes through the system of pipes. The feed-water, whether feeding or not, enters the boiler through a distributing pipe and falls over the tubes in a fine spray, thus keeping the tubes cool in case of low water. 6th. Should the water get low at any time, or all out, and the system of pipes and boiler become overheated, the water would have to pass through the pipes before entering the boiler. Should any explosion occur by feeding water, it would only affect the pipes, thus saving damages to the boiler, etc. 7th. In the system of pipes, automatic valve, and bridge walls, there is caused a rapid circulation from the bottom to the top and throughout the boiler, which keeps the water at an equal temperature, and causes the boiler to be uniformly expanded and contracted, thus doing away with repairs. 8th. Owing to the thorough circulation, the boiler is kept free from sediment and scale, and all scale previously formed is gradually removed. 9th. The steam is 20 per cent hotter. 10th. No repairs are necessary; those who have used the generator for over six years testifying to that effect."

In a recent descriptive circular, Mr. Stead refers at length to the interesting experiments of Mr. Lawson (referred to at length in a previous issue of this journal), in which it is experimentally demonstrated that a boiler containing water and steam under high pressures, can be violently exploded by the sudden abstraction of a large volume of steam, which, leaving the water at a temperature much higher than that corresponding to its pressure, causes it to burst suddenly into steam. Mr. Stead claims that with his system of circulating pipes, by which the water is kept in a state of constant agitation by a rapid process of circulation, and the liberation of steam from the same is greatly facilitated, an accident from this cause would be very unlikely. In view of the fact that Mr. Law-

son has succeeded by actual experiment in proving his theory to be correct where the proper conditions exist, the claim of Mr. Stead in this connection is not without interest. While it would be hazardous, in the absence of a positive test, to affirm the strict correctness of this claim, there appear to be elements involved in the use of the Stead attachments that favor the claim.

Mr. Stead has just received an order for six boilers with his attachments, from the American Heating and Power Co., of this city. This order was given after a thorough investigation and trial of the circulating generator of Mr. Stead, in comparison with other steam boilers.

Those who wish to inform themselves further respecting Mr. Stead's improvements, may address J. C. Stead, No. 65 Kent street, Greenpoint, L. I.

Machine Riveting.

We select from the bulletin of the Hartford Steam Boiler Inspection and Insurance Co., the following article, which will be found to contain some pertinent comments on the merits of machine riveting:

There has been no little discussion among engineers as to the relative merits of hand and machine riveting. Those belonging to the old-school class of engineers have been slow to recognize any advantage in riveting by machinery, and in many boiler shops hand riveting is the practice to-day. Sir William Fairbairn advocated machine riveting more than twenty years ago. He says: "In hand riveting, it will be observed that the tightness of the joint and the soundness of the work depend upon the skill, and also upon the will, of the workmen, or those who undertake to form the joint and close the rivets. In the machine riveting neither the will nor the hand of man has anything to do with it; the machine closes the joint and forms the rivet with an unerring precision, and in no instance can imperfect work be accomplished so long

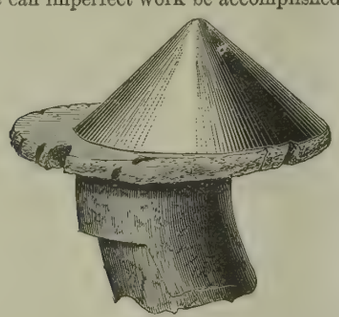


Fig. 2.

as the rivets are heated to the extent compressible by the machine. This property of unvarying soundness in the work constitutes the superiority of machine over hand riveting." Sir William says much more, and while in the main his statements are correct, there are certain important qualifications which will

Fig. 3.

appear farther on. The machine which he used, and which is illustrated in one of the volumes of "Useful Information for Engineers," was driven by a belt, and far inferior to the steam and hydraulic riveting machines of to-day. Still, with this machine he accomplished some good work, as is shown by the experiments on the strength of joints riveted up with it. The steam and hydraulic machines, as first constructed, were too light to accomplish the best results;

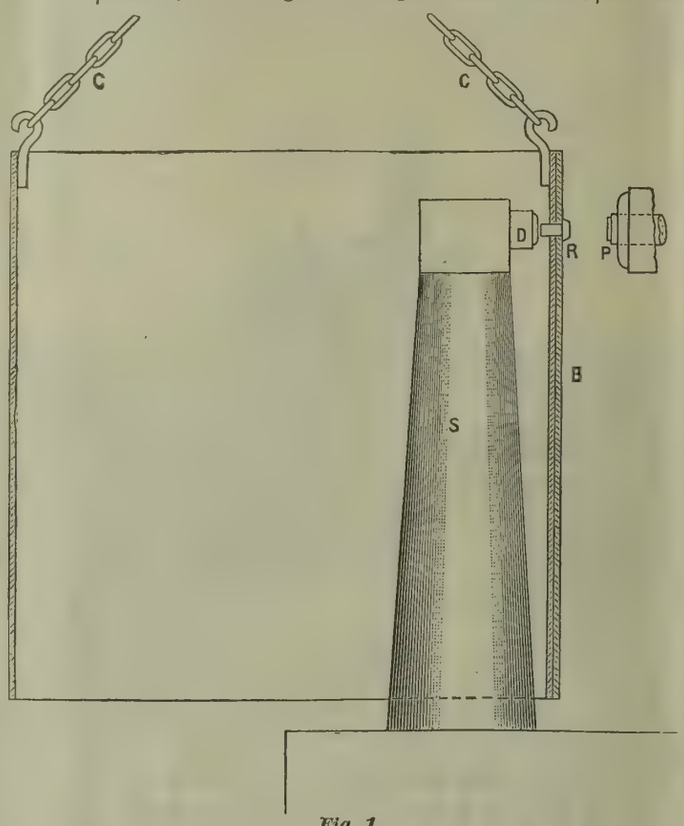


Fig. 1.

there was more or less vibration, and consequent imperfection in the joint. This difficulty has been mainly overcome by the additional strength and weight which has been given to the machines.

If, however, careful men and men of good judgment are not employed, very poor and inferior work may be done with the best machines. It is well known to those familiar with steam or hydraulic riveting machines, that there is a cup-shaped die on the end of the piston rod which presses against a fixed die. The work is brought into position for riveting by cranes. The rivet is placed in position by hand, the pressure is admitted to the cylinder and the die on the piston rod presses against the rivet head, which finds resistance against the fixed die and is pressed into shape. Fig. 1 will show the relative position of the several parts of a riveting machine; S is the standard, on the top of which is the fixed die

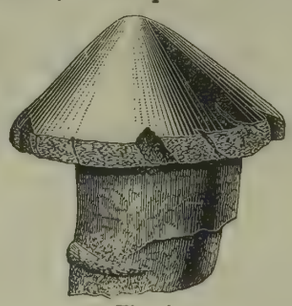


Fig. 4.

D; the piston rod die is indicated at P; the rivet R, and the section of the boiler to be riveted by B; C C shows the chains which support the section of boiler, which are attached to the crane above. Now, it will be seen that to do good work the axes of the two dies must be in exact line. If one is higher than the other, or if the piston varies to the right or left, the result will be an imperfect rivet. These errors we should not expect to find in a well made machine, under the supervision of a careful, intelligent man. But another difficulty, and one which even the best machine cannot overcome, is carelessness in the adjustment of the rivet holes in the plates to be riveted. If the axis of the rivet hole is not coincident with the axes of the dies, an imperfect rivet will be the result, and the imperfection will be increased in proportion to the variation. To make this plainer: If the man in charge is careless in adjusting his work to the machine—that is, if he elevates it too high or lowers it so that the rivet hole is a little below the dies, or if the material swings or sways to the right or left, the result will be an imperfectly formed and weak rivet. This is a difficulty that is not confined to any one shop; we have it in connection with the work of some of the best shops.

Figs. 2 to 6 are specimens of rivets which have been carelessly driven, and which we have selected from a collection of rivets that have been gathered up from different places.

From the foregoing it will be readily seen that this class of imperfect work is solely the result of carelessness on the part of the man in charge of the machine. When the boiler is all riveted up, it may be next to impossible to detect the true character of the work. But when leaks begin to appear and repairs become necessary, the defective workmanship becomes apparent. Boiler makers cannot be too careful in having competent workmen for such service, for in addition to the risk of impairing a well earned reputation, a very weak boiler may be unwittingly put to service.

Pile Driving by Electricity.—The successful application of electricity in new fields of labor continues to be recorded. At Hatfield Park (Eng.), the seat of the Marquis of Salisbury, the piles to support a coffer dam across the river Lea, have just been successfully driven by the power of a water wheel situated at a distance, which power was transmitted

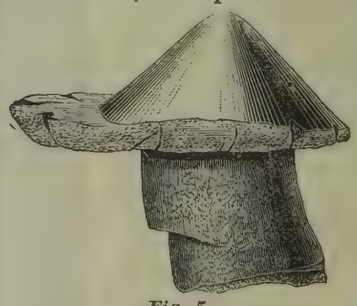


Fig. 5.

by two dynamo-machines to the gearing connected with a pile driver of ordinary construction erected on a barge floating in the river. The machinery worked well, lifting a "monkey" weighing about four hundred-weight with ease and regularity. It is

Fig. 6.

not stated how far the power was transmitted. By a French experiment, M. Deprez has succeeded in obtaining useful work after the current had passed through 49 miles of ordinary telegraph wire.

The Flow of Metals.

Most, if not all, of our readers are familiar with the phenomenon of the flow of solids from reading the admirable papers of Prof. Tyndall and others on the motion of glacier ice, and the flow of lead in the process of manufacturing lead pipe. They may not, however, be prepared to recognize the fact that a veritable flow of metal takes place with iron in the operation of punching; yet it has been demonstrated that even where this metal is punched cold, as in the operation of making cold-punched nuts, a veritable flow takes place, thus establishing the general statement formulated by M. Tresca, who has paid much attention to this subject, that "when pressure is exerted upon the surface of any material, it is transmitted into the interior of the mass from particle to particle, and tends to produce a flow of metal in the direction in which the resistance is least."

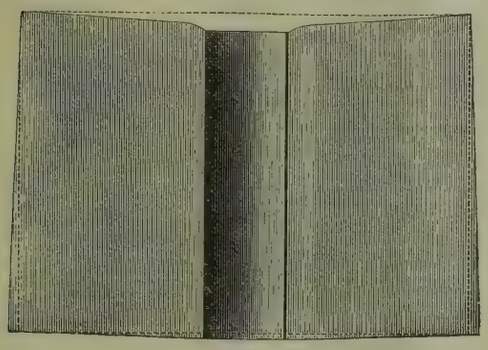


Fig. 1.

A number of experiments upon this interesting subject were lately made by Mr. David Townsend with nuts, or bars, punched cold by Messrs. Hoopes & Townsend, which proved conclusively that an actual flow does take place in metals under pressure, which is, however, governed by some law not yet wholly understood. The following statement, with the accompanying illustrations, will suffice to elucidate the subject.

Fig. 2.

Fig. 4.

One set of experiments was made with rectangular blocks of iron, which were planed accurately to the dimensions given in the table below, and then punched cold through the center of the block.

	Before Punching		After Punching					
	Width.	Thick.	Length.	Width Top.	Width Bot'm.	Thick.	Length Top.	Length Bottom.
No.	Ins.	Ins.	Ins.	Ins.	Ins.	Ins.	Ins.	Ins.
1	1.745	1.748	2.51	1.775	1.82	1.748	2.511	2.562
2	1.742	1.748	2.51	1.768	1.814	1.748	2.510	2.552

These figures show that as the punch entered, a flow took place which was greatest in the width, the direction of least resistance, the length being but slightly increased. By comparing widths at top and bottom, the increase is seen to have been greatest on the bottom face of the block. The punched block, on examination, is found to have bulged in the width, producing a curved surface, concave towards the axis, greatest at the central line of its width and decreasing gradually in either direction as it departs from that line. The length is also increased, but not as noticeably as the width. By consulting Fig. 1, it is seen that where the punch first touched the block the whole upper face is depressed, the surface converging towards the hole as the lowest point, in the immediate vicinity of which the metal curves sharply downwards, like water flowing into an orifice. The changes produced in the operation of punching in the block are shown in Fig. 1, in which the dotted lines indicate the dimensions of the block before punching, and the black lines after punching. The block has become wedge-shaped, and is slightly convex on its bottom face.

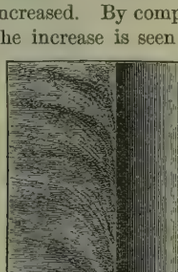


Fig. 3.

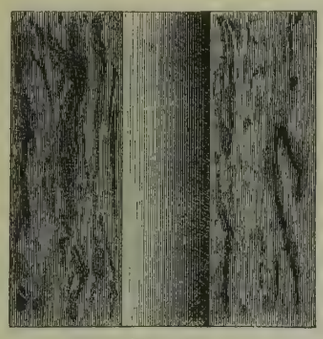


Fig. 5.

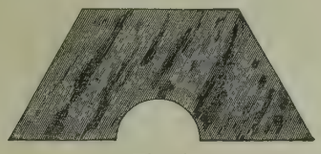


Fig. 6.

Fig. 2 represents the core punched from the block. This is found to be only $1^1/_{16}$ inches in depth, while the hole from which it came was $1\frac{3}{4}$ inches. It might at first be supposed that the metal from the hole was squeezed into the core, and that its density would be greater in correspondence to its decrease in thickness. A test of the comparative specific gravities of core and block showed, however, that this was not the case, but that the specific gravity of the core was *less* than that of the block. As the density of the core has not increased in the operation just described, it is demonstrated that a flow of the metal must have taken place from the core into the block.

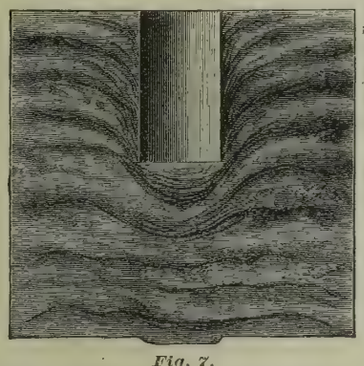


Fig. 7.

To show to the eye the flow that had occurred, several of the large nuts, with their cores, were planed in half, the resulting faces being brightly polished and then etched with acid. Their appearance after this treatment is shown in Figs.3 and 4. The curved lines mark the laminæ, or plates, which were piled and rolled together to make the bar. They all curve downward, and the greatest curvature is at the top, diminishing slightly towards the bottom, showing that the flow must have occurred when the punch first entered the bar, and continued regularly until the pressure above parted the under face and the core was forced out.

In the case represented by Figs. 5 and 6, the hole is punched with the grain instead of across the grain, and the successive laminæ, instead of being curved downwards, are wrinkled or warped from the flow.

Several experiments were made by partially punching bars of the same thickness, and the appearance of the resulting bars, when the punch has stopped at different depths, is shown on the planed, polished and etched surfaces of Figs. 7, 8, 9 and 10, showing successive stages of the operation, and demonstrating to the eye the phenomenon of the flow of the metal beyond a doubt.

The phenomenon of the flow of metals illustrated in the foregoing is interesting and instructive to a high degree, showing, as it does, that the action is not confined to such comparatively soft metals as lead, but is shared by even so hard and tough a metal as iron, making the inference justifiable that it is a property common to all metals under stress.

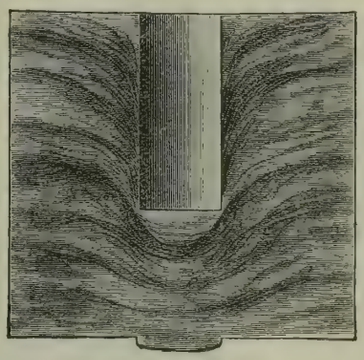


Fig. 8.

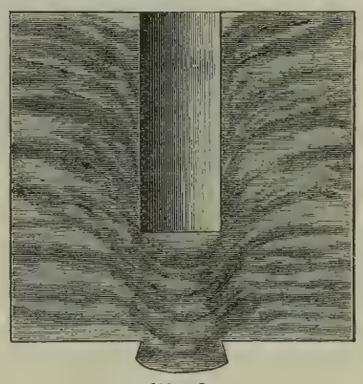


Fig. 9.

Those of our readers who may desire to read a full account of the interesting experiments of Mr. Townsend, are referred to the *Journal of the Franklin Institute*, to which we are indebted for the use of the engravings illustrating this article.

Imitation of Ground Glass.—A varnish for this object is made known by Leon Vidal, who gives the formula as, sandarac, 18 parts; mastic, 4 parts; ether, 200 parts; benzol, 80 to 100 parts.

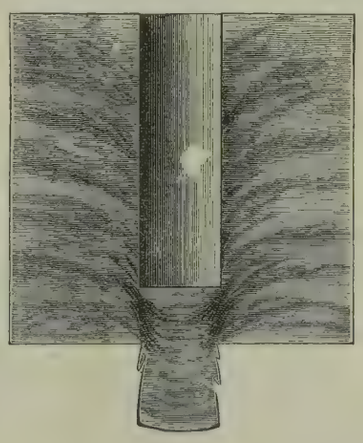


Fig. 10.

Experimental Steam Boiler Explosions.

We have the pleasure of laying before our readers a very full account of the experiments with steam boilers, made by Mr. D. T. Lawson, of Wellsville, Ohio, together with his theory and some interesting facts noted by the government commission appointed by the Secretary of the Treasury to report on these experiments. The account reads as follows:

In June last, Mr. Lawson made a series of experimental tests, using the bomb-proofs (see Fig 1) built upon the grounds of John Munhall, Esq., near Pittsburgh, Pa., by the government commissioners some years since for similar purposes, at which he exploded a new, strong boiler at a steam pressure of 290 pounds. This boiler was of the same size and strength as those used in his recent experiments, its length being 6 feet and its diameter 30 inches. The shell was of $^{3}/_{16}$-inch iron, the tensile strength was 61,449, and the heads were $\frac{5}{8}$-inch angle iron, of the same make as the shell, and braced by a 1-inch bolt running from the center of each head and firmly secured with nuts on the outside.

Fig. 1.—VIEW OF MUNHALL VALLEY, SHOWING THE ARRANGEMENT OF LAWSON'S EXPERIMENTAL BOILER.

As this was the first new and strong boiler ever intentionally exploded of which we have any knowledge, it caused wide publicity and a deep interest throughout the civilized nations, and the more so from the fact that it was consummated upon a new theory, differing widely from the many causes held by scientific and mechanical experts from the time steam was first used as a motive power.

Mr. Lawson's theory is as follows: Under the normal pressure of the atmosphere water boils at a heat of 212° Fah., and it cannot be made any hotter unless confined under pressure, for the escaping steam will carry off the heat as fast as fire can impart it. When confined in a steam boiler, if a pressure of 10 pounds to the square inch is required, the water must be heated to 239°, at which heat we get the desired pressure. If 50 pounds pressure to the square inch is required, the heat in the water must be increased to 298°; if 100 pounds pressure would be had, the heat must reach 338° in the water, or that pressure cannot be obtained.

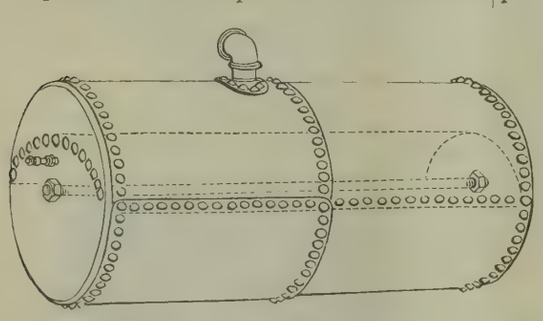


Fig. 2.—Lawson's Patent Boiler.

Now, these laws of heat and resulting pressure are as firmly fixed as the laws by which the earth revolves, and their inexorable demands must be complied with, or the terrible consequences of their violation endured. When water is thus superheated it becomes as explosive as gunpowder, but it does not explode from the same cause, nor in the same manner. Gunpowder explodes by chemical union upon ignition, and the flash is plainly visible. Superheated water explodes by a sudden reduction of the pressure from its surface, by bursting into steam, which instantly fills over 1,700 times the space occupied by the water. No man would risk his reputation for veracity by claiming that boiler explosions are accompanied with a flash, yet such must be the case if caused by gas, nitro-glycerine, or other like explosive substances, which cannot explode without a flash. Accompanying boiler explosions nothing is seen but a cloud of steam, into which the superheated water has been instantly transformed.

It is to this explosive nature of water, when heated to any considerable degree above the boiling point under the pressure of the atmosphere, that all steam boiler explosions are attributable. If water boils at 212° of heat, and is transformed into steam at that temperature under pressure of the atmosphere, and yet, by placing it under a pressure of 100 pounds to the square inch, we are enabled to impart to it a heat of 338°, it would certainly be illogical to say that it would not burst into steam instantly upon the removal of that pressure. Hence, if by any means the pressure is suddenly removed from superheated water, and a quick check met with as it bursts into steam, the concussive effect upon every square inch of the boiler is much greater than the regular pressure of the steam.

It is a well-known fact that a large majority of explosions take place at the starting of the engine, just as steam is turned into the cylinder. Now, if we look to natural law, and make the proper application, this mystery will be at once explained:

Steam being up to the desired pressure, the engineer opens the cylinder port, and instantly the steam enters the cylinder, creating a vacuum to that extent over the superheated water in the boiler, a portion of which bursts into steam to restore the reduced pressure, but is met by the valve cutting off its escape from the boiler, when instantly every square inch of the boiler is stricken with a concussive force, much greater than the regular pressure of the steam. Were it not for the excellence of the iron used in construction and the great strength with which boilers are now built, humanity would be shocked with ten explosions from this cause alone to one that now occurs. After the engine gets fairly in motion, and the liberation of steam more uniform, the danger from this cause is comparatively over.

Another and a prolific source of boiler explosions, is the sudden condensation of steam over the highly heated water in the boiler, thereby creating an instantaneous vacuum and consequent removal of pressure from the water, when instantly it bursts into steam, striking every square inch of the boiler at the same instant with a concussive force that is generally irresistible. One part of colder water thrown into contact with steam will instantly condense over one thousand seven hundred equal parts of steam. It is this fact, no doubt, that has misled so many engineers, and even scientific experts, into the erroneous belief that it was cold water coming into contact with hot iron, that frequently caused explosions. Indeed, men of unusual intelligence, culture and good judgment, have held—and it is now a prevalent and often fatal belief—that when the boiler is well filled with water there is but little or no danger of explosion, although it is demonstrable beyond a doubt that no terrific explosion has ever taken place, nor is it possible, without a large amount of highly heated water being in the boiler.

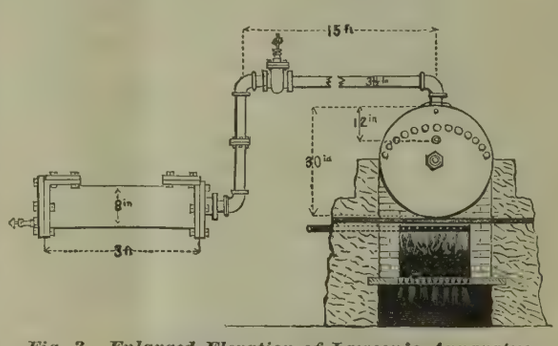


Fig. 3.—Enlarged Elevation of Lawson's Apparatus.

That the explosion of a large body of superheated water must be more destructive than a small amount, is evidenced by its highly explosive qualities. When it bursts into steam, if highly superheated, it has the capacity of filling about one thousand seven hundred and twenty times the space of its own bulk. Hence, if there should be but a small quantity in the boiler, the effect of its explosion must be but slight—a hole in a weak part, a crack in a sheet, or possibly a flue collapsed; and if persons should be in line with the escaping steam, loss of life might result; yet the boiler, under such circumstances, is seldom moved

from its bed. On the other hand, should the boiler contain a large amount of water, highly superheated, which must be its condition when high pressure is required, and explosion occurs, the effect must be always terrific. It is possible under such conditions only that rolling mills, factories, and other substantial buildings have been blown to atoms; steamboats strewn in fragments over lakes and rivers, their powerful hulls sunken and their cargoes of life and merchandise destroyed; boilers torn to shreds, filling the air with deadly missles, sometimes with ends torn out, plowing their way, like giant rockets, through stacks and buildings; or, torn asunder, one end crashing through houses, while the other is blown across a river or over a hill in another direction.

To hold that there is any explosive element connected with steam explosions, other than highly heated water, in view of the foregoing philosophical and unanswerable facts, is simply an outrage upon humanity. Any kind of water—hard or soft, saline or fresh, from lake, river or spring—if subjected to a high heat by superficial means, which requires pressure, will burst into steam the instant that pressure is removed from its surface; and if met with a sudden check, as in a closed boiler or cylinder, the strain is too often beyond the power of resistance in the boiler.

The preventive offered by Mr. Lawson is based upon the foregoing theory, and consists in constructing boilers in such a manner that the steam pressure can never be instantly removed from the water, and yet the cylinder be supplied with the required pressure. A diaphragm is placed in the upper part of the boiler, separating about two thirds of the usual steam space from the water space, as shown in Fig. 2. This diaphragm is supplied with a number of small perforations, and several small valves attached to one

Fig. 5.—3½-Inch Gate Valve.

rod, so as to be under the control of the engineer; yet all these openings in the aggregate must be less than the cylinder port. By this means the liberation of steam from the water compartment into the steam compartment, is prolonged over the time required to supply the cylinder, and after the escape to the cylinder is cut off, and while the expansion is being effected therein, the small valves and perforations in the diaphragm are charging the steam compartment with its store of power for the next stroke of the piston. Thus the pressure is never instantly removed from the water, as the steam is liberated in a constantly rising current, independently of the intermittent escape through the cylinder. To guard against instant condensation of steam in the boiler, the colder feed-water is supplied under the water, and never with a vertical injection, so that there can be no possibility of it coming into contact with the steam over the water. Cold water striking hot steam in a boiler, is like touching powder with fire. Instant condensation, which effects removal of pressure, and explosion follows.

With unbounded faith in the correctness of the foregoing principles, and encouraged by the success of his prior tests, Mr. Lawson determined to prove to the world that boilers explode from the concussive effect of bursting water, and also that he has devised

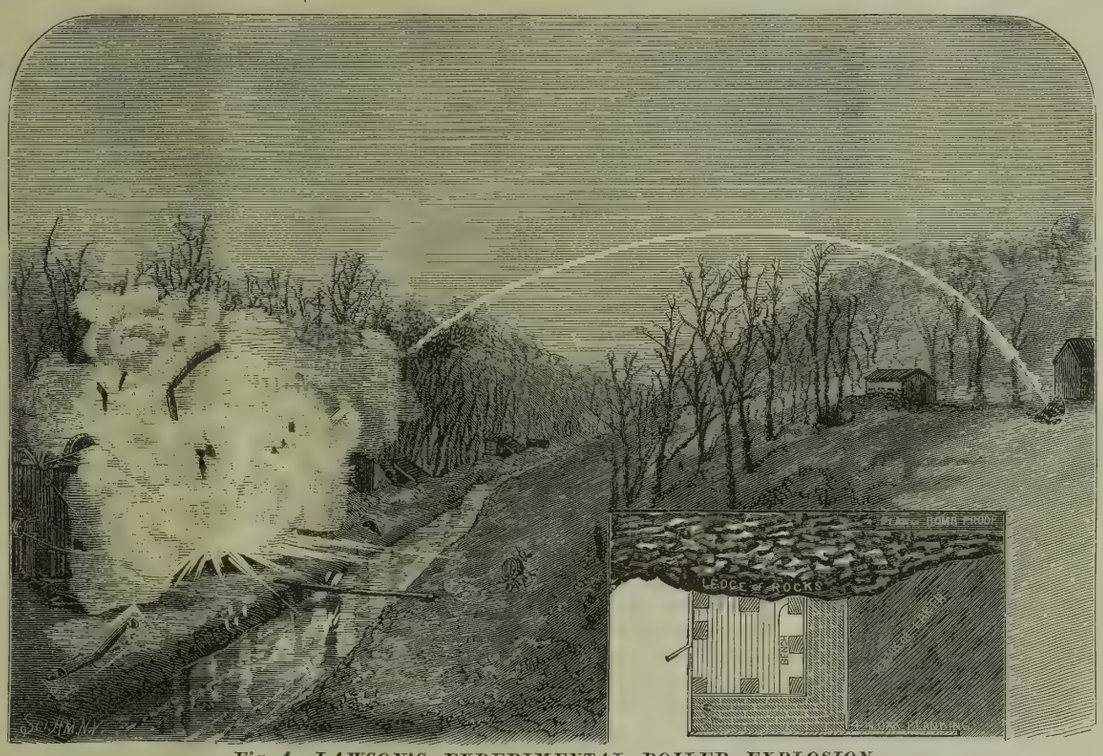


Fig. 4.—LAWSON'S EXPERIMENTAL BOILER EXPLOSION.

a sure preventive. To this end he had two boilers built, the same in size and strength of iron as the one he exploded last summer, except that one was supplied with the diaphragm above described (see Fig. 2). At his request, the Secretary of the United States Treasury appointed a commission of three experienced gentlemen to witness and report upon these experimental tests. The commission consisted of Hon. John Fehrenbatch, U. S. Supervising Inspector of Steam Vessels; Geo. H. Atkinson, U. S. Inspector of boilers of Steam Vessels; and Alonzo S. Bachelor, U. S. Assistant Inspector of Boilers of Steam Vessels, each of whom was present at all the tests, which were commenced on February 17th and terminated on the 22d of March last.

Owing to various defects in parts of the machinery, which only became manifest under a steam pressure of 130 to 220 pounds at the first several experiments, nothing of importance was accomplished. After procuring a new, quick-lifting valve (Fig. 5), with new cylinder gaskets, new lever, and new pulleys, all of which had failed at different times; and the plain cylinder boiler having been injured in the head by the use of the drift pin in enlarging the opening for the large stay bolt, it was determined to set up the boiler containing the diaphragm. Two sensitive gauges, manufactured by Wm. Kirkup & Son, Cincinnati, O., expressly for these tests, were used, one attached to the steam compartment and the other to the water compartment of the boiler, by 32 feet of ¼-inch gas pipe, leading to the bomb-proof.

On the 20th of March, fire was started with 18 inches of water in the boiler. When the steam pressure reached 50 pounds, operating the discharge valve was commenced, by which steam was thrown into a closed cylinder 8 by 36 inches in size, with results as shown in the following table:

Pressure at which discharge valve was raised.	Steam gauge above diaphragm. Needle fell below	Steam gauge above diaphragm. Needle rose above	Steam gauge below diaphragm. Needle fell below	Steam gauge below diaphragm. Needle rose above
50 lbs.	7 lbs.	3 lbs.	3 lbs.	0 lbs.
80 "	10 "	7 "	4 "	0 "
100 "	12 "	7 "	5 "	3 "
125 "	15 "	15 "	8 "	4 "
150 "	20 "	20 "	8 "	7 "
175 "	15 "	23 "	10 "	0 "
200 "	20 "	20 "	15 "	0 "
225 "	30 "	20 "	12 "	0 "
230 "	40 "	30 "	10 "	0 "
250 "	25 "	20 "	10 "	0 "
275 "	30 "	25 "	15 "	0 "
300 "	40 "	35 "	15 "	0 "

When the pressure reached 300 pounds, it was deemed prudent to lower the steam, as it was Mr. Lawson's intention to cut out the center of the diaphragm and blow up the boiler, which he felt confident he could do at a lower pressure than 300 pounds, by letting the water have its natural explosive effect by the instant removal of pressure. The fire was drawn, and when cooled down, a critical examination was made of the boiler. The water was found to be reduced to 11 inches—4 inches below the fire line, and the rivets, seams, and all other parts of the boiler seemed perfect—no strain, rupture or blemish of any kind was visible. The center of the diaphragm was then cut out (see Fig. 6), leaving about 3 inches of the plate of which the diaphragm was composed, with the flanges riveted along the shell and across the heads.

On March 22d the boiler was placed in position for the final test, with 22 inches of water, it being 7 inches above the fire line. When steam was raised to 100 pounds, the gate valve was lifted with the following results:

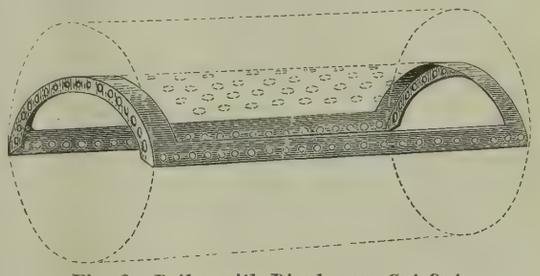


Fig. 6.—Boiler with Diaphragm Cut Out.

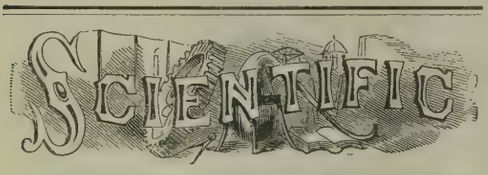
Pressure at which Valve was opened.	Steam Gauge: Needle fell below	Steam Gauge: Needle rose above
100 pounds.	3	0
125 "	2	0
150 "	5	0
175 "	4	2
200 "	5	0
210 "	3	0
225 "	5	0
235 "	Exploded.	

When the valve was lifted at a pressure of 235 pounds, the boiler was torn to shreds, with a loud report, accompanied by a storm of brick, stone, clay, grate bars and iron, which were plainly visible as they fell through the tree tops to the ground (see

Fig. 4). Not a particle of water was left—it all burst into steam. Examination of the wreck satisfied all present that it was blown into fragments at the same instant. The pieces found were torn and twisted in various shapes and sizes, some almost twisted into ropes.

It was stated by the government commissioners, who carefully tested the tensile strength of the iron, that after deducting the usual allowance for single riveting, this boiler would have carried a pressure of 430 pounds before rupturing; and as the seams, which were considered the weakest parts, remained sound, the strong iron shell being torn into strings, across joints and in all directions, at a steam pressure of only 235 pounds, the concussive effect produced on opening the valve must have been enormous.

The fact that this boiler, when it contained Mr. Lawson's device for preventing explosions was put to the severest tests possible up to 300 pounds pressure, just two days before this explosion, without injury, ought to produce the same effect on an enlightened public that was produced on the minds of the experienced gentlemen who witnessed all these tests—that Mr. Lawson's theory of steam explosions is sustained, and the great utility of his means for prevention established.



The Disaggregation of Tin.—Every now and then one of the technical journals brings to light a new case of the curious phenomenon of the disaggregation of metallic tin. This peculiarity, which appears to be confined to the metal named, has been repeatedly observed, and though it has been made the subject of much speculation at the hands of scientific men, it has never been thoroughly investigated, and we are to-day quite in the dark respecting the real cause or causes that produce this curious change of molecular structure. The change in question is at times decided enough to effect the complete disintegration and crumbling to pieces of the metal.

An account of some of the best authenticated cases of this kind will be instructive, not only in showing the character of the change effected in the metal, but also in showing how unsatisfactory are the explanations that have been offered to account for them.

At the abandonment of the Watervliet arsenal, the government had on hand a quantity of block tin that had been stored in a shed, exposed for years to the alternations of heat and cold. In removing it, many of the blocks were found to be entirely disintegrated, so that they could be cut apart as easily—so the account says—"as so much cheese." The chronicler of this case attributed the change of molecular structure, apparently without special investigation, to the alternating expansion and contraction of a metal possessing normally a highly crystalline structure.

The *Jahresbericht* (1872, page 256) gives an account by Oudemans of a similar case. A lot of plates of pure tin, containing at most 0.3 per cent of iron and lead, were disintegrated into small fragments while being transported by railway from Rotterdam to Moscow during severely cold weather. A similar phenomenon is reported by Dr. Petri to have occurred in the Royal Polytechnic Laboratory, at Spandau, where a large quantity of tin plates (over 600 pounds) first acquired lammelar exfoliations, and eventually crumbled into fine particles. Later, a larger quantity (over 4,500 pounds) was similarly affected.

In referring to this subject, one of our technical contemporaries presents the following suggestions, which have been offered as an explanation of the phenomenon: "Thin sheets of the metal especially will sometimes, if exposed to the cold for long periods, be covered with blisters, become brittle, fall to pieces, and finally to powder. The crystalline texture assumed under the influence of cold has been advanced as the probable cause of this peculiarity, while Prof. Rammelsberg suggested a dimorphism of tin based on investigations which revealed a decrease of specific gravity in the disaggregated tin, the common specific gravity being 7.29 and that of this modified tin only 7.14."

Further consideration of the subject will serve to show that none of the explanations offered are satisfactory. The case reported in the *Jahresbericht* is conclusive as proving that the presence of foreign impurities has nothing to do with the molecular change, for in this case the tin was almost chemically pure, containing no phosphorus, no sulphur, no oxide of tin, and only the merest traces of iron and lead. The case reported by Dr. Petri renders it highly improbable that moisture or severe alternations of heat and cold, or continuous mechanical vibration, occasioned the alteration, for he states that the warehouse in which the tin was kept was thoroughly dry, and that during the time the metal was stored therein there was no severe cold weather. Nevertheless, it was while thus lying undisturbed by any physical cause, that the process of disintegration went on. Dr. Petri observes incidentally, in connection with the two cases reported by him, that the disintegrated metal could be pulverized more readily than ordinary tin filings, and gave out hydrogen more quickly with acid.

That these physical causes have little or nothing to do with the phenomenon is further proved by the following cases: "In a corner of a window in Freiberg Cathedral that had been built up for a long time, a wooden box was found, which, when opened, not without some shaking, showed the fragments of a tin medal and ring, small pieces of a reddish-gray color with the surprisingly low specific gravity of 5.8. In this case, as in the others mentioned, a metal with the usual brightness, specific gravity and other qualities of tin, was re-obtained simply by heating the gray pieces to the temperature of boiling water."

Dr. I. Walz, in 1872, was called on by the United States Ordnance Department to examine a number of pigs of metal that had been purchased as "Banca tin," and that had lain undisturbed for some time in the storehouse. One of the pigs had crumbled almost entirely to the state of a gray granular powder, and what was left of it could readily be pulverized between the fingers. In another pig the process of disintegration had already set in, but was confined to the edges. Suspecting fraud, an accurate analysis was made of the material. The result, however, disclosed the presence of nothing but metallic tin. In this case, where the specimens of disintegrated metal were seen and examined by the writer of this article, the history of the metal blocks is not given in detail; but the circumstances, as narrated, so closely resemble others we have mentioned as to render the inference reasonable that they were substantially the same. Here, then, likewise the hypotheses of long continued vibration, exposure to moisture, great variations of heat and cold, or the influence of impurities, are inadequate to explain the phenomenon.

As to the hypothesis of dimorphism (under which name it is intended to indicate that the metal has the quality of existing in two crystalline modifications, one of which would be the ordinary state of the metal, and the other the extraordinary one here referred to), this would appear to be the most reasonable explanation, and is supported by the decided difference in specific gravity shown in the cases named. It will be necessary, however, to call in the aid of the microscope to assist in deciding whether a change in crystalline form, which would be involved in a case of re-crystallization, had really occurred. This it appears has not yet been done, and the hypothesis which seems to be the most reasonable one is still purely a matter of speculation. Even should it be established as correct, we would still be almost as far from the solution of the difficulty as before, for it would still be necessary to explain the conditions which bring about, in these isolated cases, so rapid and remarkable a change of structure.

Vanadium in the Arts.—Some years ago it was discovered that the salts of this metal were admirably adapted for the production of aniline blacks, and for many other operations of printing and dyeing. The objection to their use, however, resided in their high cost, in consequence of the rarity of the metal. Nevertheless, some of the French calico printers, more than fifteen years ago, when vanadium compounds with 50 per cent of the metal were sold at nearly the price of gold, found it economical to employ them, because of their wonderful efficiency. The salt usually employed was the meta-vanadate of ammonium.

The growing demand for vanadium salts in the above mentioned branches of industry, caused the gradual cheapening of the price of its salts, by calling into play the ingenuity of chemists in improving the methods of their production, and in seeking for other and cheaper sources of supply.

Walz and others, some years ago, showed that vanadium was an almost constant accompaniment of iron ores; and it now appears that the compounds of this metal may be cheaply obtained from the slags which accumulate in quantity at all large iron works. In this way, aniline blacks have been produced for some years, at one of the leading French establishments, from certain slags of the Creusot works, and with the most satisfactory results.

About the beginning of the present year, the announcement was made in France that great quantities of vanadium had been observed to exist in the silicates of the alkaline earths remaining from the manufacture of steel by the Thomas and Gilchrist process. The phosphoretted cast iron contains vanadium, which is oxidized on blowing in air, and remains in the slag. The slags contain, on an average, 1 per cent of metallic vanadium, and by selecting the slags, 2 per cent may be obtained. On treating the slags with muriatic acid, a solution of a vanadium salt is obtained, which, in spite of the presence of impurities, may be used at once for printing. With 200 parts of muriatic acid at 32° Tw., 100 parts of ground and sifted slags may be perfectly extracted. The powder is stirred up in twice its weight of water, and the acid is added gradually, stirring constantly; a little sulphuretted hydrogen escapes, and the silica separates out as soon as a temperature of 158° Fah. is reached. Then 600 parts are added. The solution is allowed to stand, filtered, and left to deposit a little more silica. The extract of 2 ounces of ground slag is said to be sufficient for 1.750 pints of color.

From the above, it appears that so far from being a rare substance, vanadium is comparatively common. When one considers the enormous masses of slag formed in the extensive operations of steel making, the fact that they contain as much as 1 per cent of vanadium, means that many tons of the metal could be profitably extracted from this source should there be a demand for such large quantities. We have here again confirmed, the fact that experience respecting supposedly rare substances is uniformly the same. The substance is rare so long as there are no uses for it; but so soon as it is found to possess useful or valuable properties, we are astonished to find how common it is. It is not much more than twenty years ago since paraffin was a chemical curiosity not to be found outside of the laboratory, and glycerine was unknown in the arts.

Brilliant Display of the Aurora.—A remarkable display of the aurora borealis was witnessed in New York city on the night of April 16th, and it attracted the attention of thousands. Groups of people gathered on the street corners and in the parks and open places, and watched with exclamations of surprise and admiration the singular appearance in the heavens. Early in the evening a low broad arch of

greenish light formed in the north, spanning a wide arc of the horizon, and occasionally sending up flickering tongues which reached the zenith. Later the appearances became more complicated and beautiful. Shafts of light, sometimes tinged with a rosy hue, shot up from the east, west and north, and, meeting a few degrees south of the zenith, gathered in a crown encircling the brilliant star Arcturus. This crown of light was in constant motion, waving to and fro, and continually changing in brightness. Sometimes one side of it appeared to be broken away, and at other times all semblance of a crown was lost, and it shone as a great, irregular disk of light. In the meantime, from every side the flashing and flickering flames, shifting from green to red, shot upward, and the whole heavens seemed to be covered with a mass of burning gas, the stars growing pale by contrast. Sometimes the light seemed to be rolling up towards the zenith in rapid waves, then it shot in streaks, and again rose in broad curtains, which waved to and fro, as if a mysterious wind was swaying them. Overhead great bands of light appeared with startling suddenness in spots where the sky had been perfectly black before, and, darting forward with a tremulous motion, joined the shining crown near the zenith.

About midnight the display along the horizon shifted from the northeast around through the north point to the southeast, where the light became very brilliant. The auroral shafts then shot upward from every point of the compass and joined the crown overhead. Within the circle of this crown the sky was black, and in the center shone Arcturus undimmed by the glow around it, although all the surrounding stars were extinguished. The display seemed to attain its greatest brilliancy about 1 A.M., when the strong flashes of light appeared as bright as sheet lighting, and the crown overhead forming a perfect circle, glowed with extraordinary beauty.

As is always the case in great electric storms, the telegraph wir s were affected all over the country, and messages were delayed. This outburst of the aurora is undoubtedly connected with disturbances in the sun. Repeated observations have shown that such a connection exists, but science has yet to learn how to interpret its manifestations. An exceedingly remarkable group of sun spots, which is now visible without a telescope as a black dot on the surface of the sun, may have some connection with the cause of the aurora.

INFLUENCE OF COMETS ON THE EARTH.—Prof. Lewis Boss, Director of Dudley Observatory, Albany, N. Y., lately received the Warner prize of $200 for the best essay on "Comets; their Composition, Purpose and Effect on the Earth." From this article, which contains many interesting and instructive facts, we condense the following statements respecting the influence of cometary bodies on the earth—a topic concerning which there is much popular curiosity, and much misapprehension.

The mass (quantity of matter) of comets is conceded to be very small in comparison with that of the earth. How small it is, we cannot say. No comet has been found large enough to exert an appreciable attraction upon any celestial body found in its vicinity. This fact confirms the conclusion, derived from telescopic examination, that the real, solid nucleus, if it exists, must be extremely small. On the whole, it is probable that there is a solid, or partly liquid, body near the center of the comet. This body is more likely to consist of an aggregation of loosely cohering particles than of a single firmly united mass.

The influence of comets upon the earth is, in all probability, quite insignificant. They may, like the sun, affect the earth's magnetic condition, and thus to some extent, possibly, its meteorology. No such effect has ever been perceived. In spite of some chance coincidences between the apparitions of great comets and remarkable public events, no well-informed person now believes that there is any real connection between them. By a liberal and credulous interpretation of any frequently occurring celestial phenomenon, similar coincidences might be shown.

When a comet is converted into meteoric bodies, which impinge upon the earth's atmosphere, there is some direct, though probably minute, effect. Some have thought that a sensible portion of the heat which the earth receives is generated in this way; but the weight of scientific opinion seems to be against that hypothesis. The impact of meteors upon our atmosphere must add some matter to it, and this is probably in the form of dust. This may be the origin of the so-called cosmic dust, which has been collected at sea in recent times. The finer particles of it may have some influence on cloud formations and other meteorological phenomena, but all this is merely conjecture.

A more remote effect may be sought in the possible fall of meteors and comets upon the surface of the sun. Owing to his vast bulk, the sun would attract an immense number of these bodies; but it is quite certain that their effect upon the sun's heat is insignificant. It is now generally admitted that we must look for the origin of the sun's heat in a constant, though to us imperceptible, shrinkage of his vast bulk. [In this connection, compare the statement of Prof. Boss with the views of Prof. C. A. Young, of Princeton College. See article on "The Source of Solar Heat," in our issue for January, 1881, page 14].

Some connection between the frequency of sun spots and comets has been rather vaguely suspected. Were the search for comets systematically pursued with equal persistence for a long period, we might have some data for the formation of a sound opinion. Yet it would still be an open question whether comets cause the spots, or whether greater activity of the sun tends in some way to render comets brighter, so that more will be visible, with the probability in favor of the latter supposition.

ELECTRO-MOTORS.—It is but as yesterday that it was first seriously proposed to employ electricity as a cheap motor for heavy work, and already wonderful progress has been made. The experiment carried out at Leytonstone, where a tram car was run by an electro-motor driven by a number of Faure's secondary batteries, is the most important public trial yet made, and it may soon lead to most important results. Roughly stated, the tests at Leytonstone were in this wise: A tram car was fitted with an electro-motor, which was geared to the wheels by a merely makeshift arrangement of toothed wheels. Under the seats of the car were placed some of Faure's secondary batteries. These batteries had been charged previously by a dynamo-electric machine driven by a steam engine. The electric energy stored up in the secondary batteries was used to drive the car by means of the electro-motor; and this it did very effectually, several good runs being made.

It has been shown by actual experiment that a Faure accumulator, weighing about 300 pounds, will drive a tram car with forty-six passengers for a journey of two miles. It is, therefore, practicable to run tram cars without either horses or steam engines, each tram car carrying its own motive power; and by the establishment of a suitable number of stations, fitted with gas or steam engines and dynamo-electric machines, a constant supply of motive power could be stored up in Faure accumulators, ready for use. In this way lines of tram cars, and even omnibuses, could be worked without horses, and with the absence of that noise and nuisance which a locomotive causes.

THE PASSIVE STATE OF IRON.—A peculiar condition of the metal, in which it is found to be indifferent to the action of substances that ordinarily exert a powerful chemical action upon it, has been studied by Ramann, with the following results: He affirms that iron is rendered passive when it is heated in the air, when it forms the positive electrode of a galvanic couple, and also when it is immersed in any of the following named liquids—nitric acid, solutions of the nitrates of ammonium, iron, silver, aluminum, nickel and cobalt. The passive state, he holds, is due to a firm coating of the magnetic oxide on the surface of the metal, this oxide being sparingly soluble in strong nitric acid, but freely soluble in dilute nitric acid. Finely divided iron, which has been immersed in any of the above liquids, and has been carefully dried in a current of an indifferent gas, may be shown to contain a considerable quantity of oxide by the formation of water when ignited in a current of hydrogen. When iron is dipped in nitric acid, a portion of the metal dissolves, forming ferric nitrate, which is reduced to ferrous nitrate by the excess of iron present. A further reduction then takes place, the ferrous nitrate being converted into ammonia and magnetic oxide

SIMES' PROCESS OF REFINING CAMPHOR.—Referring to the highly interesting article on camphor which appeared in our February and March numbers, and especially that portion of it which relates to the procedure of Mr. William F. Simes for producing refined camphor in the form of compressed blocks and flowers, which article has been widely copied by the technical journals of this and other countries, we take this opportunity, in order to do away with any misapprehension that may arise from it, to add the statement that his process in all essential details, is protected by letters-patent of the United States, as well as of Great Britain, France and other European countries, and is therefore not public property. As the omission to state this fact, in connection with the description of the process, was an oversight that might possibly result in serious detriment to the inventor's interests, we cheerfully publish this statement as an act of justice to Mr. Simes, to whose patient and intelligently directed ingenuity we owe this substantial improvement in the arts.

ALUMINUM SILVER is an alloy made by fusion of one part of silver with three or four of aluminum. It is highly spoken of as a useful metal for such articles as instruments for marine observations, where lightness and unalterability are desirable qualities. [Why not also for civil engineering instruments?—*Ed. M. & B.*] It is reported that sextants and other nautical instruments made of this alloy have been warmly approved by navigators. The metallic portions of such instruments, when made of the new alloy, weigh only about one-fourth as much as on the instruments in common use. The alloy is said to work easily in the lathe and under the file, which is not the case with pure aluminum.

ANALYSIS OF DEAD SEA SALT.—A German chemist has made an analysis of the salts that are dissolved in the water of the Dead Sea. The result leaves hardly a doubt in his mind that this lake, traversed as it is by the Jordan, and fed chiefly by it, owes its peculiar water to a rock-salt bed, and, in the first instance, to the upper layers, which contain much magnesia. In a liter he found the following substances in the proportions named: Chloride of potassium, 16.9 grains; chloride of sodium, 74.051; bromide of sodium, 5.024 grains; chloride of magnesium, 128.105 grains; chloride of calcium, 35.355 grains; sulphate of lime, 1.211 grains—a total of 260.646 grains of salts.

THE "CRY OF TIN."—If a piece of tin is bent, it emits a sound, which, being regarded as peculiar to tin, has been called the "cry of tin." It is known to be due to the crystalline structure of the metal, and is not characteristic of tin only, but may be emitted by zinc, and probably by other metals which are crystalline in texture. Rolling in the case of tin and zinc, and probably in other cases, destroys the property. It has been suggested that the sound emitted by metals might be made use of, with the aid of the microphone, in determining the strength of the metal in question; and that by such means important results might be obtained with this instrument when applied to the testing of beams, girders and the like,

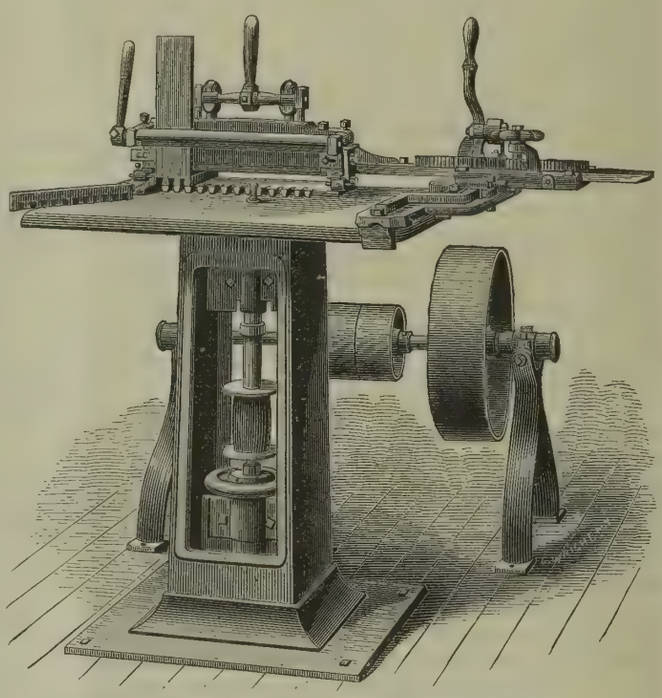
Boult's Independent Dovetailer.

The dovetailer shown in the accompanying illustration is the standard dovetailer of the Battle Creek Machinery Co., of Battle Creek, Mich., long and successfully used in connection with Boult's molder and planer, but has recently been placed upon a substantial frame designed for its use. The rig, as here shown, dispenses with many of the features necessary in a combined machine, but not intended for dovetailing solely. By this means cost is reduced without lowering the efficiency of a dovetailer. The frame is in one solid casting, with an iron top 30 inches square, planed smooth and true. In the center of the trunk, and upon the solid parts thereof, is erected the spindle, the upper journal of which runs in a babbitted box, while the lower journal runs in a brass box and rests upon a tempered steel pivot, which latter is provided with a screw and hand-wheel for vertical adjustment. The cutter, in revolving, makes the outline of an inverted truncated cone. It is held to the spindle by a short steel taper chuck, keeping it tight and in line, at the same time permitting of ready removal for sharpening or replacing.

The piece or pieces to be dovetailed are clamped to the guide bar, shown at the back, and this bar being brought forward, presents the material to the rotating cutter, which will remove the material for both parts of the dovetail at once. The finger-bar guide is retired, brought over one space, and then forward to cut the next dovetail. The distance between the dovetails corresponds to the distance between the guide fingers. The depth of the cut is regulated by a stop; the hight of the cut is varied by raising or lowering the spindle and cutter. If the stuff is very narrow, two fronts and two sides can be cut at once.

The machine as shown works stuff up to 13 inches wide, and from ¼ to 1½ inches thick, inclusive.

They also make to order a larger dovetail attachment, working lumber up to 25 inches wide and from ¼ to 1¾ inches in thickness, at only a slightly advanced cost.



BOULT'S INDEPENDENT DOVETAILER.

Fire-Proof Construction.

Gen. M. C. Meigs, U. S. A., expresses some very sensible opinions respecting fire-proof buildings, in a lengthy communication on the subject, *apropos* of the Park Row fire, that we have such good cause to remember. He disposes very effectually of the popular delusion that iron is a fire-proof material, in the following language:

"Iron is not fire-proof. It is, in fact, a combustible, and with heat enough not only bends and yields, but actually burns up. It resists a moderate heat; and when partly covered by brick arches, exposing only the lower edge, it will stand for some time. But in such fierce fires as break out in the great manufactories and warehouses of London, New York, Philadelphia and Chicago, where large quantities of inflammable goods are piled up beneath ceilings supported on rolled iron beams, they yield, and, in falling, ruin all floors below. If protected by thick plaster, upon wire cloth or netting, or by tiles so molded as to cover the lower side of the lower flange, they will stand longer; but even then they are not considered by the writer to be entirely safe in great fires. Cast and wrought iron in the form of story-posts and pillars also quickly yield to the heat of these great fires. No stone, unless of horizontal section, covering more floor space than can be ordinarily spared, will safely resist these fires, and when iron or stone yields, it yields suddenly and disastrously. A more unsafe staircase than one of slate upon wrought iron beams can hardly be made. Slate explodes [This term is rather strong.—*Ed. M. & B.*] under a moderate heat, like granite, but with greater violence. I have seen the occupants of a new log hut in Lookout Valley driven out of it by the flying slate of the walls of its chimney and open fireplace."

"Brick," he holds, "is the only real fire-proof material available at reasonable commercial cost, and it should be used in masses of considerable thickness to be safe. Light, square pillars will not stand; piers of some thickness, and of considerable horizontal length, will long resist fire. The safest story-post is one of some hard and non-resinous wood. Posts of oak, 14 inches square, will stand safely through almost any fire until the powerful force and means of our city departments are able to quench it. If wrapped with wire netting, and covered afterwards with plaster, they will suffer still less; but the naked wooden post will remain cool and strong in its center for hours, and the fire will not for a long time char it to a depth sufficient to much injure its strength.

"A good floor can be made on the plan so well advocated by Mr. Edward Atkinson, with one or two layers of thick plank, tongued and grooved, or splined, resting on stout beams 8 to 12 inches wide, and of sufficient depth to give the necessary strength. For this floor he recommends a course of plastering on wire netting inclosing the beam, and following the lower surfaces of the plank so as to leave no empty concealed spaces in which the fire can find a hidden lodgement."

The *Builder and Wood-Worker*, commenting on the above, adds that all stone stairs and posts are dangerous in great fires. Limestone calcines, sandstone cracks, and granite and slate explode with violence. Captain Shaw, of the London Fire Brigade, in an excellent treatise published in 1872, states that his men were not permitted to enter, in case of fire, warehouses in which there were iron or stone story-posts or floor beams, or ever to attempt to use stone stairs. He had seen stone stairs lying in a heap at the bottom of the stairway after a very moderate fire. The stairs of Roman houses are universally of brick. The landings are brick arches of very slight rise turned across the ends of the staircase, and the flights of stairs rest on inclined brick arches springing from the edge of one landing to the next above at the other end of the well. The upper surface of these arches are brought to the form of a flight of steps.

The same journal advocates another measure in connection with floors that is worthy of consideration—namely, that they should be constructed so as to be in a measure water-tight, on something of the same principle as the deck of a ship, so that in the event of a fire in the upper stories the damage which now necessarily ensues by reason of the deluge of water applied may be obviated. As it is now, more damage is frequently done by water than by fire. To meet this difficulty, the writer proposes to calk the floors of a building so as to make them water-tight, and to provide a gutter around each room communicating with pipes piercing the walls, to carry away the water as a rain-water pipe now does. This may seem to be an unnecessary precaution, but in the case of buildings occupied for the storage of valuable and perishable goods and property that would be ruined by water, there is no doubt but that such a provision against damage by water is quite as sensible as to provide against fire.

Phytocollite in Pennsylvania.

A jelly-like carbonaceous mineral, resembling dopplerite, was found in a peat bog at Scranton, Pa., a short time ago. The substance forms thin veins in the muck at the bottom of the bog, is black in color, and when first taken out, is, as above stated, jelly-like in consistency. On exposure to the air, however, it becomes tough and elastic, somewhat like India rubber, and when in this condition a thin slice can be cut with a knife. When completely air-dried it is as brittle and nearly as hard as coal, and resembles jet, having a brilliant resinous luster and conchoidal fracture; its specific gravity is 1.032. Before drying it burns slowly in a Bunsen burner and without flame, but when dry it burns with a clear, yellow flame. It dissolves partly in hot alcohol, but wholly in caustic potash, even in the cold. An analysis made by Mr. J. M. Stinson, of the Pennsylvania Geological Survey, of the material dried at 100° C., gave the following results:

C	H	N	O	Ash.
28.99	5.17	2.46	56.98	6.40=100.00

Analysis of the dry separated material showed it to contain:

	Per cent.
Volatile matter	72.19
Fixed carbon	21.41
Ash	6.40
Total	100.00

In physical character this substance very closely resembles dopplerite, but is different in composition. A correspondent of the *Scientific American* states that something similar to this substance is found in probably large quantities in Florida, Orange county N. Y. the experiment was made a few years since of sinking a well in a tract of bog meadow with a well auger, such as is used in sandy localities. At a depth of 20 feet a jelly-like muck was found closely resembling the phytocollite here described. It seemed to be in layers of vegetable matter and clay for a depth 10 or 12 feet, then a tough blue clay was entered. It was thought by those interested in the undertaking that this same substance was underlying the whole meadow district, which is miles in extent. It can only be guessed whether this is one of the stages from peat to coal, but an excellent fuel has been obtained by drying the substance taken from near the surface.

The Steamship "Alaska," of the Guion line, lately made the passage of the Atlantic in 7 days 6 hours and 43 minutes, actual time, thus winning the distinction of being at the head of the list of fast ocean vessels. The quickest passage previous to this one, was made by the "Arizona," of the same line, in 7 days, 7 hours, and 48 minutes.

An Improved System of Heating and Ventilation.

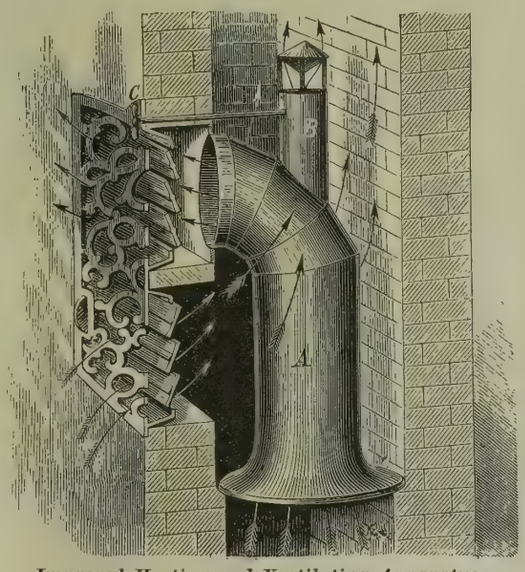
The subject of the proper heating and ventilation of dwelling houses and public buildings is one that is at length coming to receive at the hands of architects and builders something of the serious attention to which its importance as the first of sanitary considerations entitles it. It was not so long ago, as most of our readers will remember, when the constructor of a building, even of some pretensions, scarcely deemed the problem of heating and ventilating it worthy of his professional consideration, or if he gave it any thought, it was to dismiss it to the charge of some irresponsible, and probably ignorant, subordinate. Of late years, happily, there has been so pronounced a change in public sentiment upon all matters relating to household sanitation, as to amount to a positive revolution from indifference to anxiety, and heating and ventilation are matters which are ranked as high in value and importance as drainage and sewerage, and receive as much attention at the hands of intelligent constructors as the latter.

To heat and ventilate buildings comfortably and properly is by no means the easy task that one unfamiliar with such matters would imagine. We are sufficiently well acquainted with the laws governing the circulation of aerial currents, to be able to affirm that we know the principles upon which such a system should be based; but to carry them into successful practice is a task that has puzzled the brains of the ablest constructors. The heating alone, or the ventilation even, would not prove so serious a task, but to properly combine the two, so that, as it should be, the one shall supplement the other, and both combined shall form an effective system, operating in conformity with sanitary principles, is an undertaking, the difficulty of which can only be duly appreciated by one who has undertaken it. In many cases, too, the most obvious blunders are committed, and persisted in, in the apparently simple problem of ventilation. An old custom for a long time, and even yet to some extent in vogue, was to admit fresh air at a low level in the room, and allow it to escape at a high level, on the mistaken notion that the vitiated air of the apartment that has been breathed, being warm as it issues from the lungs, would rise, and that the placing of a ventilating register at the top of the room, to effect its withdrawal, solved the problem. This notion is entirely wrong. The vitiated air expelled from the lungs speedily acquires the temperature of the stratum of air into which it enters, and, heavily laden with carbonic acid and water vapor, sinks to the floor, and unless removed by some means, accumulates there in a stratum of constantly increasing volume. To attempt to remove this stratum of vitiated air by providing openings for its escape at the top of the room, is simply absurd; and it is not only incorrect in principle, but wasteful of heat (and consequently of fuel), for the warm, fresh air entering the apartment, no matter at what level, being specifically lighter than the air already in the room, immediately rises to the ceiling and escapes through the ventilating apertures without warming the apartment, leaving the bulk of the vitiated air of the apartment undisturbed. Intelligent observers have, therefore, in view of these facts, come to the conclusion, that, both for the efficient renewal of the air of an apartment and for economy of heat, the proper plan is to have the openings for the escape of foul air near the floor.

The preceding remarks will serve to introduce a description of the combined heating and ventilating apparatus, and which is at once simple in construction, rational in principle, and effective in operation.

In describing the steps that led the inventor of this apparatus to the desired construction, it will be well to note the circumstance, which he claims to have proved by actual experiment, that in a room warmed by a supply of heated air, delivered through a register near the floor, the *coolest* spot in the room is invariably directly below the entering stream of warm air. How the inventor took advantage of this fact, in connection with the general principles previously announced, will shortly appear. We owe this very simple and efficient system to the ingenuity of the late George R. Barker, of Germantown, Philadelphia, by whom it was introduced with most satisfactory results into many public buildings and private residences in Philadelphia and its vicinity. It will be understood from the following description:

The air in a room is in a constant state of circulation; delivered from a register, it rises; reaching the ceiling, it moves across the room, and, being gradually cooled falls to the floor. There it is, and must be drawn off and removed in some thorough and simple way. Our illustration, partly in perspective and partly in section, shows the invention quite clearly. A supplementary flue A, flared at its lower end, surmounts the flue leading from the furnace. This pipe is smaller than the air flue, leaving a space all around between it and the walls of the air flue for ventilation. Its upper extremity is curved to terminate in



Improved Heating and Ventilating Apparatus.

the upper half of a register, through which the hot air is delivered into the room. It will be observed that the register, though having a single grating of the usual size, is divided by a horizontal partition, and each portion is provided with a separate set of slats, either of which may be opened or closed at will. While the hot air from the flue A pours into the room in an ascending current, as indicated by the arrows, the cold and heavy vitiated air, which sinks to the floor, makes its exit into the lower half of the register, entering the main flue in the space between the supplementary pipe and the brick-work, and thence passing up the chimney. By this means a constant circulation of air is maintained in the apartment.

It will be noticed from the foregoing account of the Barker apparatus, that the draft of the flue which is used for ventilation is materially increased by the warmth of the galvanized iron pipe through which the fresh warm air is delivered to the apartment. Its action is at once simple and rational, effecting a frequent and thorough change and renewal of the air of the room to which it is applied, and by the completeness of the circulation which it establishes and maintains effecting a considerable economy of heat, representing a corresponding economy of fuel.

The thoroughness of the circulation effected by this apparatus, has another and highly important advantage—namely, that of producing a very nearly uniform temperature in all parts of the room. With this simple apparatus then, operating automatically, it is claimed, and we believe without exaggeration, that the problem of wholesome heating and ventilation, involving the essential conditions of comfortable warming, frequent and thorough renewal of the air, and the maintenance of practically uniform temperature throughout the apartment, is solved, affording an experimental demonstration of the fallacy of the argument that the only way to secure efficient ventilation is to force the air into or out of a room by machinery.

The following additional details respecting the mechanical operation of the Barker apparatus are of interest to note: The small pipe B arranged above the flue A, is provided within with a valve operated by a suitable rod and handle C outside the register. By this device either a portion or the whole of the hot air rising in the flue A may be discharged into the vitiated air flue, the register of the hot-air pipe being either opened or closed accordingly, and thus increasing the warmth and consequently the draft of the vitiated air flue, a result of much importance in crowded rooms, where the heat becomes excessive and the air very impure. From our own personal observation of the practical operation of the device, we feel satisfied that the truth of the views above noted is fully proved—a candle or handkerchief held before the two portions of the combined register indicating clearly the direction of the ingress and egress currents. By a simple modification the device is adapted for floor registers, and in cases where several flues pass up the wall side by side, a metal partition is used to separate each at the point of location of its register, enabling the apparatus to be conveniently and readily applied. The invention has already elicited favorable notice from eminent sanitary authorities in this city, Philadelphia and Washington. This apparatus has been introduced with great success all through the hospital and medical departments of the University of Pennsylvania; the new public school buildings, Camden, N. J.; the People's Bank (Girard Building), the City National Bank, the Western Saving Fund, the Baptist Publication Building, Memorial Hall (Art Building), Philadelphia Stock Exchange, and in many private residences in Philadelphia.

The following commendations which the apparatus has received are of interest in connection with what has preceded, in confirming the statements we have made respecting it. The eminent respectability of the source from which they are derived affords the best evidence of their value. The first is the report of the Committee of Science and the Arts of the Franklin Institute, and is as follows: "The Committee on Science and the Arts constituted by the Franklin Institute of the State of Pennsylvania, for the promotion of the mechanic arts, to whom was referred for examination George R. Barker's combined heating and ventilating flue apparatus, report that they have carefully examined Mr. Barker's apparatus for ventilation, both in model and as exemplified in the Franklin Institute building, and conclude that it is the best in efficiency and simplicity that has been brought to our notice. The combination is a very ingenious one, and the experiments submitted prove the inventor's claim to be well sustained."

The second is extracted from the reports of the judges at the last exhibition of the same Institution:

"Warm air on entering an apartment from a register to a certain extent heats the floor and adjacent parts; this, combined with the momentum of the entering and ascending of the warm-air current, causes to be formed a much expanded or rarefied air space between the ascending current and the floor, with a tendency of the cooler and more or less vitiated air that has made the circuit of the apartment to flow into this rarefied space, an under current being thus created over the surface of the floor. Mr. Barker has taken advantage of the movement of this under current to increase its movement and withdraw it to a certain extent from the apartment; this is accomplished by placing in the brick warm-air flue a short metal pipe with a trum-

pot-formed mouth at its lower end, a quarter bend at the upper; the trumpet-formed mouth extending down in the flue to a few inches below the floor of the apartment and fitting tightly around the side of the flue causes all the warm air to pass up through the pipe. This pipe is smaller than the air-flue, leaving a space all around between it and the walls of the air-flue or an additional flue for ventilation; a double register, made one-half for inlet and the other for outlet, is placed in the wall, the inlet compartment to the room being uppermost, covering the opening to the bent end of the warm-air inlet pipe—the outlet compartment extending to near the floor of the apartment. The operation is thus: The warm air in passing through this pipe keeps it comparatively hot, thereby warming and expanding the surrounding air in the ventilating portion of the flue; and the comparatively dense current previously established along the floor toward this point is drawn on through the register, into and up the flue by reason of its warmth and the rarefaction it produces. By this arrangement it is evident that a constant circulation of air must be maintained within the apartment, so long as warm air is passing through the pipe, which is always the time when the introduction of cold currents from without would be most dangerous or uncomfortable. The apparatus is inexpensive and readily applied, and can be modified and arranged so as to be made applicable in numerous places. We believe it to be a good and efficient arrangement for the purposes intended."

Those desiring to make further inquiries respecting this apparatus, or to interest themselves in introducing it, are invited to correspond with Mr. S. M. Barker, 1807 G street, Washington, D. C.

Market Report of Building Materials.

NEW YORK PRICES.

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LUMBER.

Pine, very choice and extra dry, ₩ M	$60 00 @ 70 00
Pine, good	55 00 @ 60 00
Pine, shipping box	21 00 @ 22 50
Pine, common box	18 00 @ 20 00
Pine, common box ⅝	16 00 @ 18 00
Pine, tally plank, 1¼, 10 inch, dressed each	— 44 @ — 50
Pine, tally plank, 1¼, 2d quality	— 35 @ — 38
Pine, tally plank, 1¼, culls	— 28 @ — 30
Pine, tally boards, dressed, good	— 30 @ — 32
Pine, tally boards, dressed, common	— 25 @ — 28
Pine, tally boards, culls, dressed	— 23 @ — 25
Pine, strip boards, merchantable	— 18 @ — 20
Pine, strip boards, clear	— 24 @ — 26
Pine, strip plank, dressed, clear	— 33 @ — 35
Spruce boards, dressed	— 25 @ — 27
Spruce plank, 1¼ inch, dressed	— 28 @ — 30
Spruce plank, 2 inch	— 43 @ — 45
Spruce wall strips	— 15 @ — 16
Spruce timber, ₩ M	20 00 @ 25 00
Hemlock boards, ₩ M	17 00 @ 18 00
Hemlock joist, 2½x4, each	— 16 @ — 17
Hemlock joist, 3x4	— 18 @ — 20
Hemlock joist, 4x6	— 40 @ — 44
Ash, good, ₩ M	55 00 @ — —
Oak	60 00 @ 65 00
Maple culls	25 00 @ 30 00
Maple good	45 00 @ 50 00
Chestnut	48 00 @ 52 00
Cypress, 1, 1½, 2, and 2½-inch	35 00 @ 40 00
Black Walnut, good to choice	115 00 @125 00
Black walnut, ⅝-inch	85 00 @100 00
Black walnut, selected, and seasoned	150 00 @175 00
Black walnut, counters, ₩ ft	— 22 @ — 28
Cherry, wide, ₩ M	100 00 @120 00
Cherry, ordinary	60 00 @ 80 00
White wood, inch	45 00 @ 50 00
White wood, ⅝-inch	35 00 @ 40 00
White wood, ⅝ panels	45 00 @ 50 00
Shingles, extra sawed pine, 18-inch	4 00 @ 5 00
Shingles, clear sawed pine, 16-inch	3 75 @ 4 00
Shingles, cypress, 24x6	18 00 @ 20 00
Shingles, cypress, 20x6	10 00 @ 12 00
Lath, Cargo rate	2 20 @ 2 25
Yellow dressed pine flooring	30 00 @ 40 00
Yellow pine girders	32 50 @ 40 00
Locust posts, 8 feet, ₩ inch	— 18 @ — 20
Locust posts, 10 feet	— 24 @ — 25
Locust posts, 12 feet	— 29 @ — 34
Chestnut posts, ₩ ft	— 3 @ —3½
Basswood ₩ M	25 00 @ 30 00

Cargo rates 10 ₩ cent off.

CEMENT—PER BARREL.

Portland (imported)	2 75 @ 3 50
Portland (American)	2 50 @ 2 75
Portland (Lafarge)	3 40 @ 3 65
Lime of Teil	2 30 @ 2 50
Lime of Teil, ₩ ton	15 00 @ 18 00
Roman	2 75 @ 3 40
Keene's & Martin's, coarse	6 00 @ 6 50
" fine	10 50 @ 10 75
Rosendale	1 10 @ 1 20

SOLDERS.

Half an half	16½ @ — 16¾
Extra	15½ @ — 15¾
No. 1	13½ @ — 13¾

ZINC.—Dull, sheet, ₩ ℔, 2½ cents.

Sheet (cask) ₩ ℔	7⅞ @ — 8
Sheet (open)	8¼ @ — 8½

BRICKS.

	Cargo.		Afloat.
Pale, ₩ M	4 50	@	5 00
Up Rivers	—	@	— —
Jersey	9 50	@	10 00
Haverstraw Bay	— —	@	— —
" " choice	11 00	@	11 25
Favorite Brands	— —	@	— —
Hollow Fire-Clay Brick	9 00	@	9 25

FRONTS.

Croton—Brown, ₩ M	11 25	@	— —
" Dark	13 25	@	— —
" Red	13 25	@	— —
Philadelphia	35 00	@	— —
Trenton	35 00	@	— —
Baltimore	45 00	@	— —
Clark's Glens Falls, White	30 00	@	— —
" " Red Fronts	27 50	@	— —
" " Molded Red and White	45 00	@	80 00

Yard prices 50 cents ₩ M higher, or with delivery added $2 ₩ M for hard and $3 ₩ M for front brick. For delivery add $5 on Philadelphia, Trenton and Glens Falls and $6 on Baltimore brick.

STONE.—Cargo Rates Delivered in New York.

Amherst Sandstone, No. 1, buff, in rough, ₩ c. f.	1 00	@	— —
do do No. 2	— 85	@	— 95
Bedford Stone	1 25	@	— —
Berlin Freestone, in rough	— 75	@	1 00
Berea Freestone, in rough	— 75	@	1 00
Brown Stone, Portland, Conn	1 00	@	1 35
Bay of Fundy Wood Point Brown Stone	1 00	@	— —
do Mary Point Brown Stone	1 00	@	— —
do do Olive Stone	1 00	@	— —
Brown Stone, Belleville, N. J	1 00	@	1 35
Granite, rough	— 60	@	1 25
Canaan Marble	1 25	@	1 50
Sutherland Falls Marble	1 25	@	1 75
Dorchester, N. B., Stone, rough, ₩ foot	1 00	@	— —

IRON—PER TON.

Duty.—Bar, 1 to 1½c. ₩ ℔.; Railroad, 70c. ₩ 100 ℔.; Boiler and Plate, 1½c. ₩ ℔.; Sheet, Band, Hoop, and Scroll, 1¼ to 1¾c. ₩ ℔.; Pig, $7 ₩ ton; Polished Sheet, 3c. ₩ ℔. Galvanized, 2½c. ₩ ℔.; Scrap cast, $6 ₩ ton; Scrap Wrought, $8 ₩ ton—all less 10 ₩ cent. No Bar Iron to pay a less duty than 35 ₩ cent ad val.

Pig, Scotch—Coltness	25 50	@	26 00
" Glengarnock	24 00	@	24 50
" Eglinton	22 50	@	23 00
" American, No. 1	25 00	@	26 00
" American, No. 2	23 00	@	24 50
" American forge	22 50	@	23 00

LEAD—PER 100 POUNDS.

German	— —	@	— —
English, common	— —	@	— —
Spanish	5 75	@	— —
Foreign, refined	— —	@	— —
Bar	6 50	@	— —
Sheet	7 50	@	— —
Pipe	— —	@	— —
Domestic	4 63	@	— —

TIN PLATES.—Duty, 1 7/10 cents ₩ ℔.

I. C. charcoal, 10x14, ₩ box	6 25	@	6 50
I. C. coke, 10x14	5 25	@	5 75
I. X. charcoal, 10x14	8 25	@	8 37½
I. C. charcoal, 14x20	6 25	@	6 50
I. X. charcoal, 14x20	8 25	@	8 37½
I. C. coke, 14x20	5 25	@	5 75
I. C. coke, terne, 14x20	5 25	@	5 37½
I. C. charcoal, terne, 14x20	5 50	@	5 75

NAILS—PER KEG.

10d to 60d, common, fence and sheathing	3 30	@	3 40
8d and 9d, common	3 65	@	— —
6d and 7d, common	3 90	@	— —
4d and 5d, common	4 15	@	— —
3d and 4d, light	4 95	@	— —
3d, fine	5 65	@	— —
2d, fine	5 65	@	— —
Cut spikes, all sizes	3 65	@	— —
Clinch nails, 1½ to 1¾ inch	5 65	@	— —
do. 2 to 2½ inch	5 40	@	— —
do. 2½ to 2¾ inch	5 15	@	— —
do. 3 inch and longer	4 90	@	— —

PAINTS.

Carmine, American, ₩ ℔	5 00	@	5 25
Chalk, ₩ 100 ℔s	— 35	@	— —
China Clay, ₩ ton	18 00	@	20 00
Chrome yellow, dry, ₩ ℔	— 12½	@	— 28
Lead, red American, ₩ ℔	— 6¾	@	— 7
Lead, white American, pure, in oil	— 7½	@	— 8
Lead, white American, pure, dry	— 6¾	@	— 7
Lead, white English, pure, in oil	— 9	@	— 10
Litharge	— 6¾	@	— 7
Ocher, Fr., dry, ₩ 100 ℔s	1 50	@	— —
Ocher, ground, in oil, ₩ ℔	— 6	@	— 15
Ocher, Vermont, ₩ 100 ℔s	— 75	@	1 00
Orange Mineral, English	— 9	@	— 10
Paris White, American	— 1½	@	— 1¾
Paris White, English, prime	— 2	@	— 2¼
Paris Green	— 15	@	— 28
Plumbago paint, patent, ₩ ℔	— —	@	— 25
Putty, ₩ ℔	— 2	@	— 2½
Spanish Brown, dry, ₩ ℔	— 1½	@	— 1¾
Spanish Brown, ground in oil, ₩ ℔	— 8	@	— 9
Venetian red, ₩ cwt	1 75	@	2 00
Vermilion, Chinese, ₩ ℔	— 85	@	— 90
Vermilion, Trieste	— 70	@	— 75
Vermilion, quicksilver, bags	— 50	@	— 52½
Vermilion, American, common	— 15	@	— 18
Whiting, ₩ 100 ℔s	— 60	@	— 80
Zinc, white American, dry, No. 1	— 5	@	— 7½
Zinc, white American, No. 1, in oil	— 8	@	— 10
Zinc, white French, dry, (Red Seal,)	— 7	@	— 8
Zinc, white French, in oil	— 10	@	— 10½

VARNISHES—PER GALLON.

American Wearing Body	3 50	@	4 00
Coach Body	2 35	@	3 50
"	1 80	@	2 00
Furniture	1 25	@	2 50
Black Asphaltum	1 00	@	1 50
Brown Japan	1 00	@	1 20
Liquid Paint Dryer	1 35	@	1 75
Harness, (black)	3 00	@	4 50
Shellac, Spirits	3 00	@	3 50

LIME—PER BARREL.

State, common	1 15	@	1 20
" finishing	1 35	@	1 40
Rockland, common cargo rate	1 10	@	— —
" finishing	1 30	@	— —
Ground	1 25	@	— —

Add 25 cents to above figures for yard rates.

HAIR.

Cattle, ₩ bushel of 7 ℔s	— 16	@	— 18
Goat " "	— 25	@	— 28

SLATE.

Purple, roofing slate, ₩ square	$6 00	@	7 00
Green Slate	6 00	@	7 00
Red Slate	13 00	@	— —
Black Slate, Pennsylvania, (at Jersey City)	4 75	@	5 25
Slate tiles, 1¼-inch, rubbed, ₩ square foot	— 20	@	— 25

PLASTER PARIS.

Duty.—20 ₩ cent ad. val. on calcined; lump free.

Calcined, ordinary city, ₩ bbl	1 60	@	1 75
Calcined, city casting	1 80	@	1 90
Calcined, city superfine	2 00	@	2 25

MAHOGANY.

St. Domingo, crotches, ordinary to good, ₩ ft	— 15	@	—28
St. Domingo, crotches, fine	— 20	@	—30
St. Domingo, logs, small	— 5	@	—38
St. Domingo, logs, large	— 12	@	—15
Frontera, Mexican, large	— 12	@	—15
Frontera, Mexican, small	— 6	@	— 8
Other Mexican	— 6	@	—12½
Honduras	— 6	@	—12½

ROSEWOOD.

Rio Janeiro, ordinary to good, ₩ ℔	— 2½	@	— 4½
Rio Janeiro, good to fine	— 5	@	— 8
Honduras	— 6	@	— 12½
Satin Wood, ₩ foot	— 15	@	— 75
Tulipwood, ₩ ℔	— 6	@	— 7
Lignumvitæ, large, ₩ ton	30 00	@	50 00
Lignumvitæ, other sizes	10 00	@	25 00

CEDAR.

Cuba and Mexican, small, ₩ super. ft	6	@	— 7½
Cuba and Mexican, medium	8	@	— 9½
Cuba and Mexican, large	10	@	—11
Florida, ₩ cubic foot	40	@	—75

DEADENING AND ROOFING MATERIAL.

Mineral wood for Roofs and deadening, ₩ ℔ — 1¼ @ —1½

LABOR.

Ordinary, ₩ day	2 00	@	2 50
Masons, do	3 50	@	4 00
Plasterers, do	4 00	@	— —
Carpenters, do	4 00	@	— —
Plumbers, do	4 00	@	4 50
Painters, do	3 00	@	3 50
Stone-Cutters, do	3 00	@	3 50

REVIEW OF THE MARKETS.—In the lumber market occasionally some attempts to talk "bullish" have been noted during the past month, but as a rule the tendency has been to look matters squarely in the face and admit the situation as unfavorable for sellers on pretty much all kinds of stock. Two influences have tended to bring this out more prominently, one being the gradual completion of old work and quite as slow and indifferent preparation for new jobs as was predicted, and the other an increasing offering and more or less softening on transportation charges, permitting cheaper basis for negotiation. The market is not falling all to pieces by any means, and especially on fine and choice stocks, but simply goes down step by step as the gradual shrinkage of demand lessens the supports, and this must continue until buyers think the cost safe for investment in stock against unknown future wants.

The general features of the market for bricks have remained much the same as advised in our last report. Supplies have been moderate from all sources, and found an exhaust as soon as offered, with occasional engagements ahead of arrival, and this advantage permitted sellers to dictate pretty much their own terms.

In the lime market, the irregularity noted last month has finally developed into a further decline, with common Rockland marked down to $1.10 per bbl., and for the present only nominally steady.

In the cement market Rosendale has been in good demand on both local and shipping account, and the market well sustained, with some attempts made to stimulate values, but without success.

In the lath market demand has continued fair, but stock has come in upon receivers a little too freely, and they have been obliged to modify their views. Receivers report moderate amounts of desirable goods afloat, and seem to be hopeful, but it is also evident that dealers are not so anxious as they were, and it would require only a few cargoes to form a surplus in first hands.

In the hardware market some deliveries have been made on old orders, but the amount of new business done has been very small, and confined mainly to odd lots required to fill out assortments. The market, in fact, has become quite dull, and dealers have felt much less cheerful over the situation than for some time past. Builders' hardware in particular has disappointed estimates of sales, for consumption and jobbers have felt disposed to rest content for the present with the amount they have on hand.

An Improved Water-Closet.

We describe in what follows, with the aid of the accompanying illustrations, an improved water-closet, which, to use the words of the makers, is a self-emptying, automatic water-closet, that takes care of itself, is simple and positive in operation, clean in use, and all that it should be in a sanitary point of view. To this improved device the makers have attached the expressive title of the "Tidal Wave" water-closet.

It is made of one single piece of white earthenware, dispensing with plug, soil-valve, floats, float-chambers, putty and cement joints, and complicated supply valves.

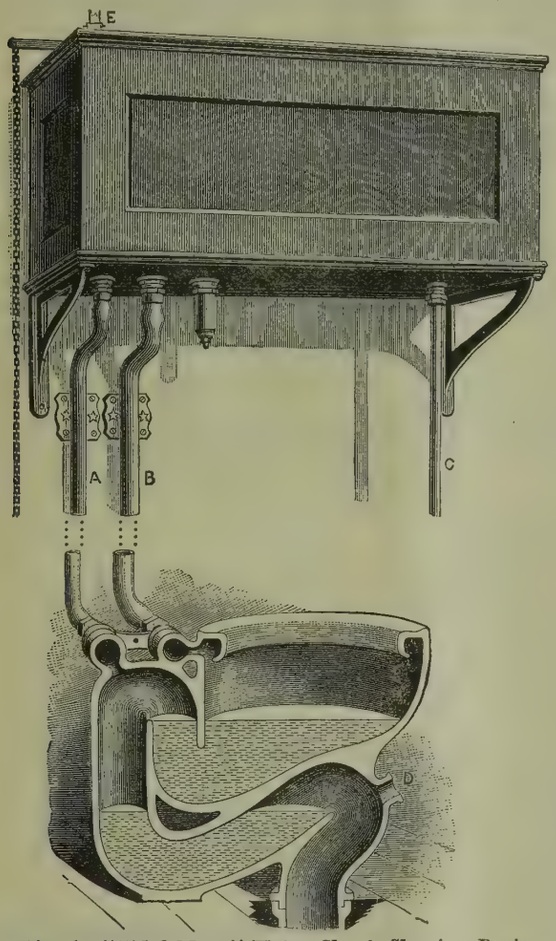


Fig. 1.—"Tidal Wave" Water-Closet, Showing Basin and Supply-Tank Connections.

Referring to Fig. 1, A is a ⅜-inch air and ventilating pipe; B, a 1¼-inch flushing pipe; C, the supply pipe; and D and E, vents. The construction of the basin is such that a large body of water is retained in the bowl by a trap of unusual dip, under any circumstances, while a second trap directly under the bowl, in connection with the vent at D, forms an additional safeguard against sewer gas. The closet is provided with a copper-lined tank, with service box of the usual construction, and can be operated by a lever and chain attached to the closet seat in the usual manner, or by a bell-pull, or by an ordinary closet-pull. The seat attachment (see Fig. 2) is automatic, as will be seen from the following description, and is a most desirable feature in connection with apparatus of this class, being especially adapted for the use of children and others too thoughtless to make use of mechanical devices. From the following description the working of the apparatus will be understood: While the seat is occupied, the service box fills, the water expelling the air from the service box into the ventilating flue E at the top of the tank. Relieving the seat changes the position of the valves in the service box, closing the supply and opening the outlet valve to the flushing pipe B. The water rushing down to the flushing rim of the bowl, creates a partial vacuum in the service box and air pipe A, causing the air between the two traps to rarefy, and the contents of the bowl are instantaneously discharged into the lower trap, starting at the same time a continuous 4-inch siphon which carries everything with it into the soil pipe. The vacuum is broken after the water in the service box has run off to the extent of two-thirds, and the remaining one-third of water in the service box is reserved to refill the bowl.

The closet here described can readily be substituted for any other in use, without changing the soil pipe connections. It can be reversed, so as to be conveniently supplied either from the right or the left, and the supply tank can be placed at any desired hight from the floor.

Those of our readers who may desire to see the closet in operation, are invited to visit the warerooms of the makers, Henry Huber & Co., 85 Beekman street, this city.

The Advantages of Two Eyes.

W. Le Conte Stevens, in the *Popular Science Monthly*, offers the following explanation in response to the question, "What is the use of having two eyes?" The answer has been given, "To have one left if the other is hurt." Much as we may admire the sagacious foresight of this youthful physiologist, it will not be found sufficient to rest contented with his ultimatum. He had evidently not tried his skill to find how unexpectedly he would miss the inkstand while endeavoring to dip his pen into it at arm's length, with one eye closed. He had not thought of holding his finger a few inches in front of his face to find what part of the wall it would hide from each eye in succession, or how differently it would look when regarded from those two points of view separately; how much thicker it would appear when both eyes were open; how readily he could examine three sides of it at once; how much more definitely he could judge its distance—in a word, how much more comprehensive was the information given by two eyes if used at the same moment. Assuming that he knows exactly how to account for the inversion of the retinal image and the erect appearance of the object there pictured; how our visual perceptions are only signs of what we momentarily feel on the retina, signs that generally represent the realities with a fair degree of accuracy, but may sometimes represent almost anything else on demand; how, if the eyes be healthy, we have no consciousness of possessing any retina at all, but instantly and unconsciously refer every retinal sensation to some external body whose existence we are obliged to assume, unless there be special arguments to convince us to the contrary—granting all this, our young physiologist has not thought of inquiring how it is that, although two retinal images are produced, we see but a single object, and this despite the fact that, like photographs of the same body simultaneously taken from different standpoints, these two images are necessarily dissimilar.

Metallic Designs on Glass by Photography may be obtained as follows: The glass is first silvered by one of the several processes in use for the purpose, then covered with a thin coating of sensitive bitumen, which is exposed beneath a transparency to the action of the light. The unaltered bitumen is then washed off with spirits of turpentine, and a picture of the design in bitumen remains behind. By applying moderately strong nitric acid, the silver, where it is not protected by the bitumen, can readily be dissolved off, so that the metallic design shows like a mirror from the reverse side. The plate may be backed by paint or other suitable material.

Exhibition of School Models and Plans.

In June next is to be opened in Paris an exhibition, under the auspices of the Government, of plans and models for school buildings of all kinds, which will be of great interest to architects and others concerned in educational matters. Of late years the science of school building has been carried in France to a hight at least equal to that attained in Germany. The best methods of heating, lighting and ventilation have been thoroughly studied, and under the lead of the distinguished Trelat many structures have been built in which the principles deduced from observation have been thoroughly carried out. To the accepted theory of school-room lighting, that the windows should be on the left of the pupils as seated, M. Trelat adds a refinement of his own, that the light should come from one large window, rather than from several, divided by piers which cast long shadows across the room. To obtain the requisite area of glass—one-sixth of the floor space—in this way, it is necessary to make the single window very large, so lofty in fact that its top would extend beyond the ceiling of a room restricted to the hight ascertained to be most suitable for such apartments; and to meet this difficulty some of the new school houses are built with ceilings *inclined* to an angle of some twenty degrees with the horizontal, so that the left, or window side, is about twice as high as the other. Cross ventilation, which the French justly consider indispensable, is secured by openings in the wall opposite the windows, screened with louvre boards or blinds. So radical a modification of the ordinary forms as this, would be slowly accepted even in this land of eccentricities, but if we prefer to follow at a long distance the example of more logical nations, it would still be worth our while to make ourselves acquainted with what has been done, by some sort of representation at the approaching show.

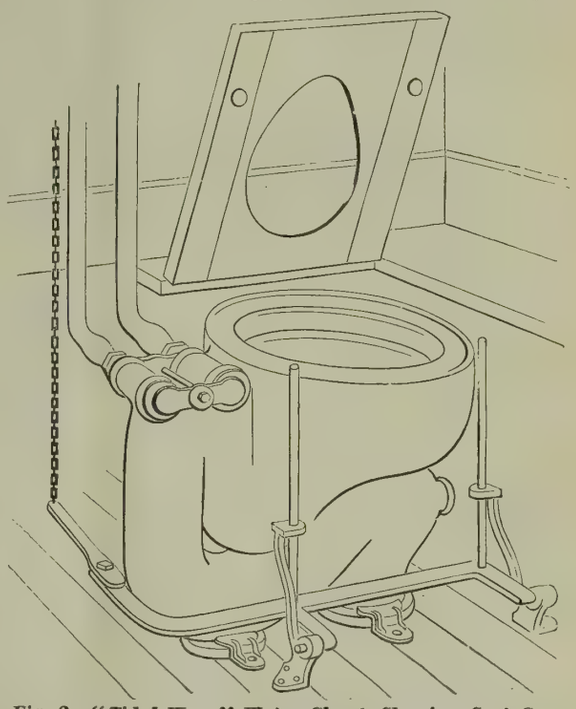


Fig. 2.—"Tidal Wave" Water-Closet, Showing Seat Connections with Supply Tank.

The Hair.

The hair and nails, according to the best authorities, from whom we glean the following facts, are simply portions of the epidermis, or outer layer of the skin, altered in shape and structure to fulfill the ends assigned them. But the hairs are situated much more deeply than one might infer from this statement, and the longest and largest of them reach down through the entire thickness of the true skin or derm. The finest—downy hairs—however, are very superficially inserted. Almost the entire surface of the body is provided with hairs of some sort, with a few exceptions, as the palms of the hands, the soles of the feet, etc., though over some portions of the surface they are so fine as to be hardly discernible with the naked eye.

Each hair is divisible into two portions—the root and the free extremity. The root is somewhat pear-shaped—that is, a trifle larger below than at the surface of the skin, and its tissue is much softer than the exposed portion of the hair; it is, indeed, succulent in the act of growing. At the deepest portion of the hair-follicle, or cavity in which the hair rests, there is a certain anatomical structure which is of the greatest importance in reference to the growth and vitality of the hair—namely, the hair papilla. This is situated deep in the tissues, at the bottom of each hair-follicle, and projects into a small cavity at the lower end of the hair.

This little hair papilla, which is only one-fifteenth of a line, or one-180th of an inch long, is of vital importance to the life of the hair, as from it are derived the materials for the growth of the hair, there being in its interior a minute blood vessel; and it is generally believed that the reproduction of the hair, after it has been lost from any cause, takes place from this papilla. Conversely, it is also true, that as long as this papilla is intact and in a healthy state, the hair will be reproduced; and the only method of really permanently removing the hair so that it has lost the power of reproduction, is by destroying the life of the hair papilla itself.

Alopecy, or baldness, in the great majority of cases, is believed to be due to a diseased condition of the sebaceous or oil glands of the skin, which are almost invariably connected with the hair, forming appendages at the sides of the hairs, their ducts opening into the hair follicles. In the commonest form of trouble from this source (which is called by physicians "seborrhoea"), the skin upon the nose and cheeks, but more frequently upon the scalp, becomes covered with whitish or yellowish greasy scales. Upon the scalp it forms much of the so-called "dandruff," and is a very annoying complaint. Not only is it annoying from the constant shedding of the scales, like snow, upon the clothing, but it is particularly troublesome because it is surely attended, sooner or later, with loss of the hair.

Seborrhoea causes loss of the hair in two ways; first, because the hair loses its proper lubrication, which should come from the oily secretion poured upon it continually by the sebaceous glands, their secretion drying into scales; and second, because the same causes which produce the seborrhoea, operate also to undermine the nutrition of the hair, and as a consequence it falls out. The cause of the trouble is deficient vitality in these small but important organs, and it naturally terminates in baldness. The remedy, as in all cases of debility, requires the use of tonics.

It is useless to try to permanently remove the source of trouble by washing or combing the head, or by stiff brushing. These measures often aggravate it. There should be a certain amount of daily brushing, but it should be done with a comparatively soft brush. The use of a fine-toothed comb generally gives considerable relief by removing much of the adhering matter, but the irritation to the skin which follows its use aggravates the disease.

The hair often falls out after acute sicknesses, and in fact almost always after scarlatina, erysipelas of the head, etc. While it is often regained after complete restoration of the general health, this is not always the case; and the same tonic treatment as indicated in the other case will be required.

While these do not include all the causes of the loss of the hair, they cover by far the greater number of cases of this annoying and very common trouble; and wherever, as in these cases, the life of the hair-papilla is not destroyed, the evil can be remedied, the fall of hair arrested, and in many cases a fair amount of hair restored by proper treatment sufficiently long continued.

The number of secret and preparatory remedies for baldness is legion, and while it is safe to avoid the most of them as being worthless, there are some which are really efficacious. Though it is contrary to the practice of this journal to recommend preparatory medicines, there can be no objection to the statement, made upon personal knowledge, that one of these—Benton's Hair Grower, prepared by the Benton Hair Grower Co., 334 Euclid Avenue, Cleveland, O.—has proved itself in many cases to be a surprisingly efficacious restorer of the hair.

Having used this hair renewer ourselves with the greatest benefit, we can testify to its restorative virtues. We have also been shown by the company a very large number of testimonials from parties in all parts of the country, who have used the Benton Hair Grower with the most remarkable results. With these practical evidences of the reliable character of this preparation, we can cheerfully commend its use to our readers. We advise those afflicted with baldness to communicate with this company, whose advertisement will be found in another column.

Design for Seaside Cottage.

The cottage illustrated in this number has been designed by Messrs. Smith & Howe, 7 Warren street, New York, for erection, during the coming summer, at Atlantic Highlands, New Jersey.

In its arrangement and general appearance it is well adapted to its purpose, and will doubtless prove of value here as a suggestion to one wishing to build a seaside cottage at a small expense.

The rooms are all of good size and conveniently arranged, and the house is in its outline broken sufficiently to lend it picturesqueness without, in too great a degree, enhancing the cost. There is a fine piazza on the front of the house, the roof of which, as with many modern cottages, is made by continuing the main roof of the house, and a pleasing feature is obtained breaking through this main roof with the large balcony, making a delightful outlook on the water. This balcony looks from the serving-room on second story, forms, in fact, part of it, making work here, even in summer time, it would seem, almost a pleasure. The house is well supplied with closet room, and is in all respects thoroughly complete. The cost is $2,200, according to builder's estimate.

Miscellaneous and Advertising.

For freight and passenger elevators, shafting, pulleys and hangers, address L. S. Graves & Son, Rochester, N. Y.

The George Place Machinery Agency, of 121 Chambers street, this city, have always on hand a large line of new and second-hand machinery of every description.

The H. B. Smith Machine Co. are enlarging their store, 925 Market street, Philadelphia, making it 200 feet deep, to accommodate their large stock of woodworking machinery and machinists' tools.

"How to Keep Boilers Clean," and other valuable information for steam users and engineers. Book published by James F. Hotchkiss, 84 John street, New York. Mailed free to any address. (Mention this paper.)

We call attention to the advertisement in another column, of the Smith exhaust fan, manufactured by Huyett & Smith, of Detroit, Mich. This fan, since its introduction on the market, has gained a first-class reputation, and is being employed with the greatest satisfaction in many establishments throughout the United States. This firm also make pressure blowers, and will be glad to furnish any particulars desired with reference to their machines, on application.

The Clinton Wire Cloth Company—established in 1856—have doubled their capacity during the past year, and are now the largest wire weavers in the world. They employ 450 hands, with a monthly product of 2,500,000 square feet. The Company are putting in 23 new looms, one being the heaviest loom ever erected for working, and will weave No. 1 wire. They are making a specialty of wire lath, for the production of which they employ one mill steadily running day and night, and since last September, two set of hands have allowed no stop to its machinery. Sufficient orders have been received to insure the running of the Company's mills 120 hours per week through the balance of the year.

Graphite Roof Paint.

The Joseph Dixon Crucible Company, of Jersey City, N. J., have some specialties that deserve the attention of builders, contractors and others.

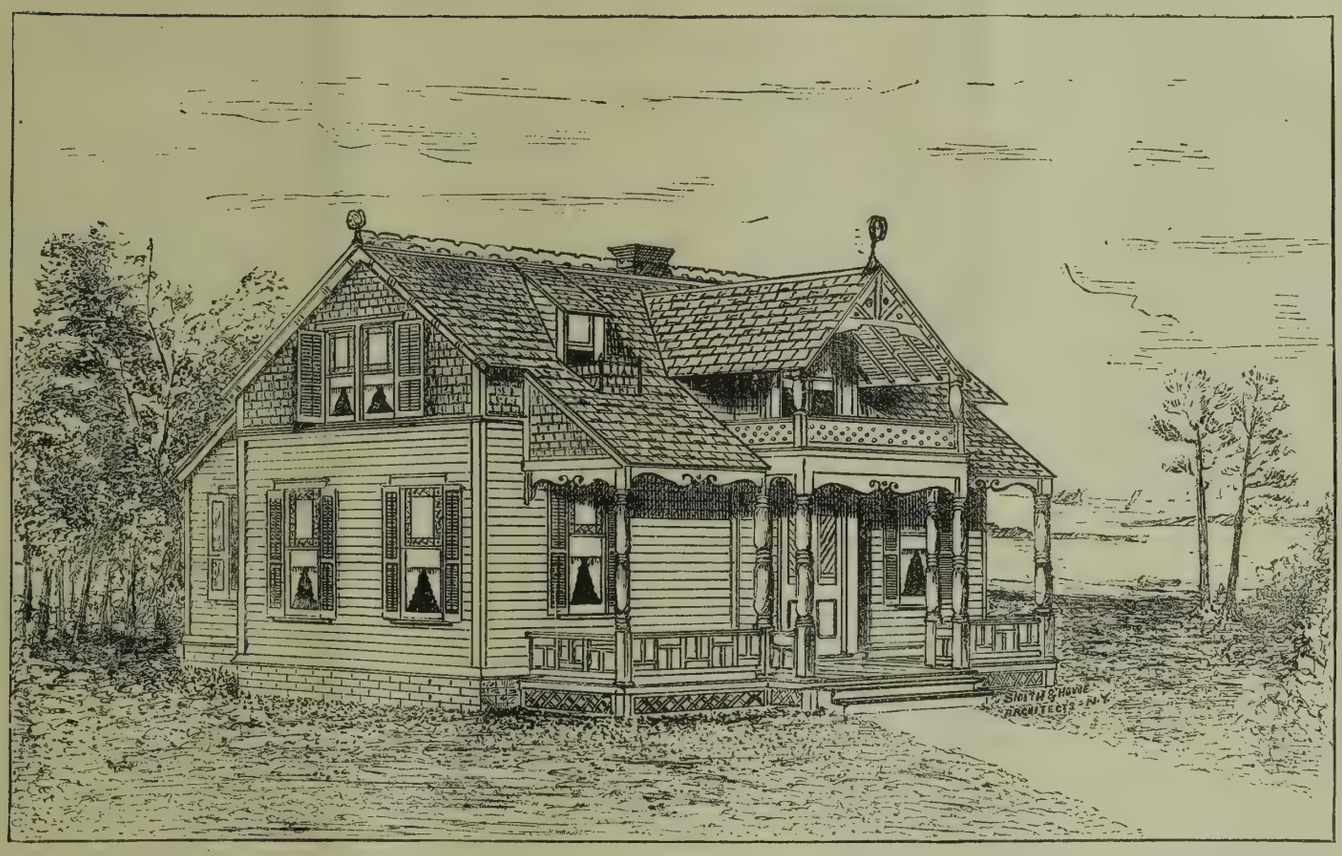
Their graphite roof paint they claim will stand 2,000° Fah. heat, any degree of cold, the salt atmosphere, or even acids. It will cover double the surface of mineral or white lead paints. It is easily laid on with the brush, and guaranteed practically everlasting. A circular explaining the subject at length, with sample of the colors, can be obtained by sending your address.

The same paint is also made, by special adaptation, useful for iron smoke stacks. It will not "burn off."

Their American graphite pencils long since took rank above all others in point of quality, economy, etc. They make this celebrated graphite into pencils for mechanical and architectural drawing, for free-hand drawing, for carpenter's use, and a special lumber pencil for lumber inspectors. Ask your dealer for these pencils; but if they are not sold by any dealer in your vicinity, write for sample, sending 9 cents in postage stamps to their address, Josph Dixon Crucible Co., Jersey City, N. J. They are the largest manufacturers in the world of graphite goods, making crucibles, stove polish, paints, lubricating oils, lubricating greases, lead pencils, carpenters' pencils, and lumber pencils, from the celebrated Ticonderoga American graphite.

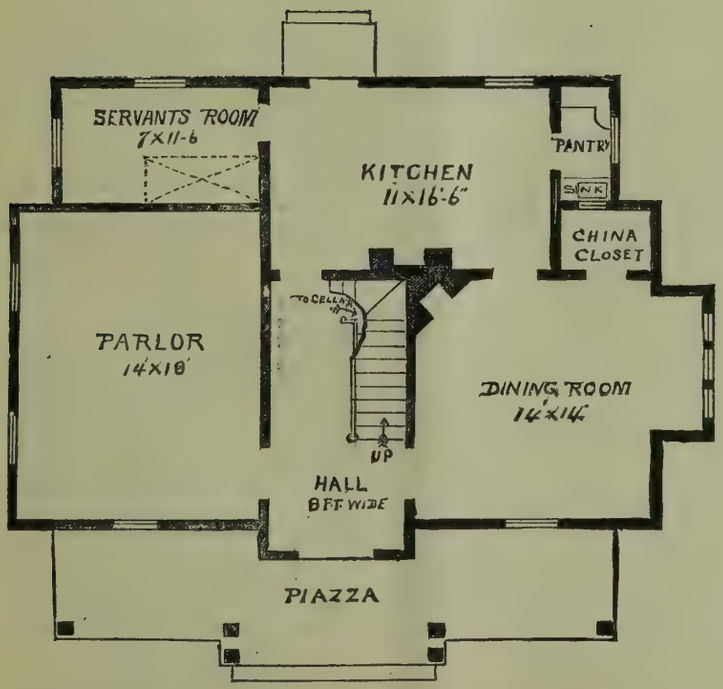
Emerson, Smith & Co.'s Saws.

Among the well-known manufacturers of saws in this country, none stand higher, so far as the quality of manufactures is the gauge of excellence, than the firm of Emerson, Smith & Co., of Beaver Falls, Pa. Their products have been extensively introduced, and are favorably known throughout the entire country. The following is a list of the more important specialties of these makers: Patent planer-toothed saws for general use; patent flange-toothed saws for general use; clipper flange-toothed saws for general use; patent clipper saws, extra thin, for lumbermen's use; Damascus tempered solid saws of all kinds; band saws of all widths and lengths, etc. The invertable circular saw tooth of these makers is of peculiar form, which is deemed to be specially advantageous for its intended purpose. A view of this tooth, showing the peculiar mode of holding it in place on the periphery of the saw, is shown in engraving in our advertising columns. These manufacturers have issued an interesting and useful "Hand-Book on Saws," containing much practical information respecting the use and care of saws, which those of our readers desiring further information on these specialties, may obtain by addressing the firm as above.

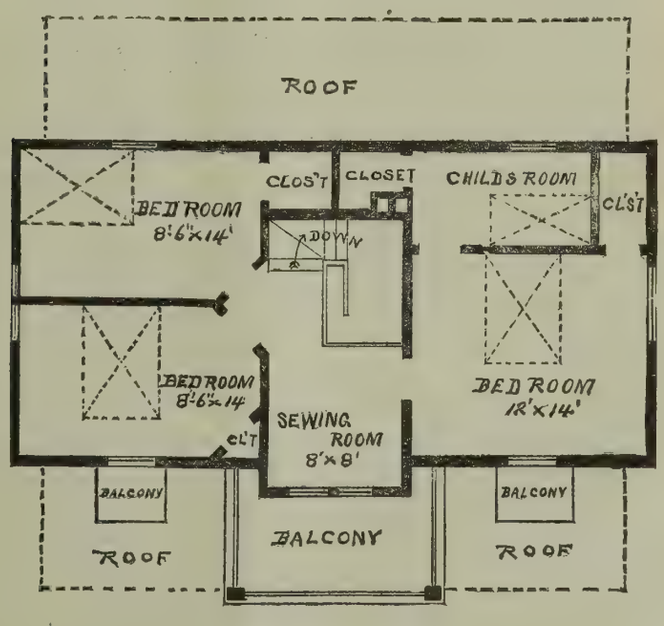


DESIGN FOR A SEASIDE COTTAGE.

ESTIMATED COST, $2,200.



FIRST STORY



SECOND STORY

Arrangement of Floor Plans.

The Precious Metals.

The annual statement of the precious metals produced in the States and Territories west of Missouri River, including British Columbia, with receipts in San Francisco by express from the west coast of Mexico, has been made to Wells, Fargo & Co., by John J. Valentine, the General Superintendent. The statement shows the aggregate products for 1881 to have been as follows: Gold, $31,869,686; silver, $45,077,829; lead, $6,361,902; copper, $1,195,000. Total gross result, $84,504,417.

California shows a decrease in gold of $579,069, and an increase in silver of $323,582. Nevada shows a total falling off of $3,184,057; the yield from the Comstock being only $1,726,162, as against $5,312,592, in 1880—a decrease of $3,586,430. The product of the Eureka district is $4,127,265, as against $4,639,025 in 1880—a decrease of $511,760. Utah shows an increase of $860,335. Colorado shows an increase of $1,672,181; and Arizona $3,726,295 over last year. The gold dust and bullion transported by express was $26,019,223; by other conveyances, $2,663,940; silver bullion by express, $25,567,824; ores and base bullion by freight, $30,253,430, making a total of $84,504,417. This amount was distributed as follows:

California	$18,020,679
Nevada	11,847,564
Oregon	1,189,615
Washington	100,963
Alaska	13,000
Idaho	2,834,474
Montana	4,359,071
Utah	7,311,288
Colorado	22,957,160
New Mexico	814,944
Dakota	3,550,950
Arizona	8,198,766
Mexico (west coast)	2,433,343
British Columbia	872,600

The bullion from the Comstock contained 47 54-100 gold, and 52 46-100 silver. Of the so-called base bullion from Nevada 44 70-100 was gold; and of the whole product of the State 26 53-100 was gold. The gross yield for 1881, as shown above, segregated, is approximately as follows:

Gold	37 71-100	$31,869,686
Silver	53 35-100	45,077,829
Lead	7 53-100	6,361,902
Copper	1 41-100	1,195,000
Total		$84,504,417

The exports of silver during the year to Japan, China, India, the Straits, etc., were as follows: From Southhampton, $21,000,000; Marseilles, $1,000,000; San Francisco, $5,000,000; Total, $27,000,000, as compared with $34,000,000 from the same places in 1880.

Escape from Burning Buildings.

Perhaps, after all, it will turn out that the most effective of the many appliances which have been proposed from time to time for escaping from a burning building will prove to be the simplest of all, viz: the shooting of arrows, with life-lines attached, to the assistance of those who have been cut off from descent by the stairways.

Since the great Park Row fire, this system of fire escape has been receiving careful consideration from scientific fireman, and the experiments made have been of a satisfactory nature. The *Washington Despatch*, of recent date, in noting the results of one of these trials made by General M. C. Meigs and two other archers, at the Wallach school-house, in that city, says that there was no difficulty in throwing an arrow, with the end of a line attached, clear over the flagstaff, about 80 feet high, and an arrow, with 150 feet of cord wound around the head, was thrown at least twice the hight of the building and flagstaff. The same paper states that the the Potomac archers propose to offer a prize to the best archer among the firemen of Washington at the close of the shooting season, which began in April and ends in November. They will ask the fire department authorities to allow some of the firemen to shoot with them from time to time.

New Publications.

Atlantis, the Antediluvian World. By Ignatius Donnelly. New York: Harper & Brothers. 1882.

In this interesting book the author has carefully collected all the facts which bear upon a tradition "that there once existed in the Atlantic ocean, opposite the mouth of the Mediterranean Sea, a large island, which was the remnant of an Atlantic continent, and known to the ancients as Atlantis; that this was the region where man first rose from a state of barbarism to civilization, and that it was destroyed in a terrible convulsion of nature, in which the whole island sunk into the ocean, with nearly all its inhabitants. A few, however, escaped in ships or on rafts, and carried to the nations east and west the tidings of the appalling catastrophe, which has survived to our time in the flood and deluge legends of the different nations of the old and new worlds."

The legend of Atlantis was preserved by the Egyptians, and the author quotes the narrative of Plato describing it. This narrative, according to Plato, was told to Solon, a relative of his, by an Egyptian priest, it constituting a part of their religious records. Various other nations have also preserved a remembrance of a similar disaster. Among these we find the Hebrews, Chaldeans, Hindoos, Phœnicians, Americans, etc. These, the author relates, show that they are similar, and in all probability are recollections of the same catastrophe. That so many widely separated races should concur in these legends is certainly strong ground for believing that they all have some basis in an occurrence which actually took place. "Even the absurdest reports may in nearly every instance be traced to an actual occurrence; and had there been no such actual occurrence, this preposterous misrepresentation of it would never have existed. Though the distorted or magnified image transmitted to us through the refractory medium of rumor, is utterly unlike the reality; yet, in the absence of the reality, there would have been no distorted or magnified image. And thus it is with human beliefs in general. Entirely wrong as they may appear, the implication is that they germinated out of actual experiences, and originally contained, and perhaps still contain, some small amount of verity. More especially may we safely assume this in the case of beliefs that have long existed and are widely diffused; and most of all so in the case of beliefs that are perennial and nearly or quite universal. The presumption that any current belief is not wholly false, gains in strength according to the number of its adherents."

The author of the present work attempts to prove, and we think in a most satisfactory manner, that these legends are the remembrances of a long-lost country known to the ancients as Atlantis. He then proceeds to show that deep-sea soundings that have been made of the bed of the Atlantic ocean by the United States ship "Dolphin," the German frigate "Gazelle," and the British ships "Hydra," "Porcupine" and "Challenger," map out on the ocean bottom an immense elevation, which corresponds in position with that of the lost Atlantis as described by Plato. This elevation, from its mountainous character, must have been produced by agencies acting above the water level, and afterwards subsided beneath the waters of the Atlantic, its tallest peaks still remaining as the Azore Islands. Our author then points out the striking similarities between the characters of the civilization on the two sides of the Atlantic, and endeavors to prove that Atlantis was the original seat of these civilizations, and that they were derived from it by colonization, the Atlanteans forming colonies in Central America, Mexico, Peru, valleys of the Amazon and Mississippi, Egypt, etc. These theories he endeavors to support from studies drawn from the architecture, language, customs, legends, etc., of these different nations.

On the whole, the book is a very interesting one, and although on some points the author is perhaps a little enthusiastic, still it is a work that should be read by every one who is interested in one of the most obscure problems of the present day—the origin of civilization. A. J. P.

Flirtation Camp; or, The Rifle, Rod and Gun in California. A Sporting Romance. By Theodore S. Van Dyke. 12mo, extra cloth, beveled edges, gilt cover design. $1.50. Fords, Howard & Hulbert, New York, Publishers.

This readable-looking volume is a very successful attempt to combine the interest of a novel with the more practical features of an authoritative work on the hunting and fishing of a country celebrated among sportsmen. It was a happy idea of the author's to set down, in that sunny, luxuriant land, known as southern California, a merry party from the East, and, by following their adventures in this happy hunting ground, under the expert guidance of a skillful chaperon familiar with the country, to impart information that all who love the rod and gun will value and enjoy.

For such information, the reputation of the author, Mr. Van Dyke, as a sportsmen of some celebrity, and as a writer on sporting matters in the best papers devoted to the gentle crafts, would lead all who are acquainted with his work to look to him as one of the most trustworthy authorities. The truthfulness of the present volume is apparent in every chapter, where even the interest of the romance cannot tempt the author to overstate the facts or color too strongly the pleasant picture. Other writers about this "Earthly Paradise" on the Pacific slope are severely condemned by Mr. Van Dyke for giving too high-colored accounts of the natural advantages of a country that needs only the truth to be told to appear attractive enough for men of reasonable desires.

The interests of those who seek lower California for the restoration of their health are discussed by Mr. Van Dyke, who warns this numerous class against the mistakes too commonly made, and gives such sound practical advice on the subject as only one can who has had thorough experience of it and abundant opportunity for observation.

As a writer Mr. Van Dyke is exceedingly clever in his descriptive work. This appears particularly in the portrayal of the striking scenery and vegetation so abundant in the region under consideration, and in the careful details given of the habits and movements of game, large and small—from the nimble quail to the stately bounding beauty—the deer of the forest.

The author has made his romance subordinate to the main purpose of his work, a sort of light, graceful, sketchy background to his more practical and serious subject. But it is none the less attractive for that. It prevents all sense of monotony in the consideration of the successive hunting scenes, or rather it adds to their zest and spirit, as the genial, healthful-souled man enjoys his pursuits all the more from their being followed in good company.

There is a pleasant flavor of merry burlesque and humor pervading the whole tale, and the reader is alternately amused with his companions, charmed with the unaffected and graphic descriptions of scenery, intensely interested in the zeal of the chase and instructed in the multifarious habits of game and arts of the sportsman. The story will be enjoyed rather by the lover of out-door life and adventure than by the ordinary novel-reader. It is a wholesome, breezy, book.

Cawker's American Flour Mill Directory for 1882. Published by E. Harrison Cawker, publisher of the "United States Miller," Milwaukee, Wis. Price, $10.

This directory, which has lately been issued, bears evidence of having been carefully and conscientiously compiled by one familiar with the trade. The arrangement of the contents is by post offices, which follow in alphabetical order, making the task of reference an easy one. Wherever it has been found possible to do so, not only the name of the mill, but the kind of power used and the capacity of the establishment in barrels of flour per day of 24 hours, are given. This information has been obtained in numerous instances, and lends special value to the work to business men who desire to reach the American milling trade. We append a few extracts of a statistical nature which the directory affords. We learn on this authority, that there are in the United States 21,356 flour mills, and in the Dominion of Canada 1,488. The mills in the United States are distributed as follows: Alabama, 388; Arizona, 17; Arkansas, 234; California, 209; Colorado, 52; Connecticut, 309; Dakota, 44; Delaware, 96; District of Columbia, 7; Florida, 81; Georgia, 514; Idaho, 18; Illinois, 1,258; Indiana, 1,163; Indian Territory, 3; Iowa, 872; Kansas, 437; Kentucky, 642; Louisiana, 41; Maine, 220; Maryland, 349; Massachusetts, 363; Michigan, 831; Minnesota, 472; Mississippi, 297; Missouri, 942; Montana, 20; Nebraska, 205; Nevada, 10; New Hampshire, 202; New Jersey, 445; New Mexico, 28; New York, 1,942; North Carolina, 556; Ohio, 1,462; Oregon, 129; Pennsylvania, 2,786; Rhode Island, 47; South Carolina, 205; Tennessee, 620; Texas, 548; Utah, 129; Vermont, 231; Virginia, 689; Washington Territory, 45; West Virginia, 404; Wisconsin, 780; Wyoming, 3; total, 21,356.

The Civil Engineer's Pocket-Book of Mensuration, Trigonometry, Surveying, Hydraulics, Hydrostatics, Instruments and their Adjustments, Strength of Materials, Masonry, Principles of Wood and Iron Roof and Bridge Trusses, Stone Bridges and Culverts, Trestles, Pillars, Suspension Bridges, Dams, Railroads, Turnouts, Turning Platforms, Water Stations, Cost of Earthwork, Foundations, Retaining Walls, etc., etc. In addition to which, the elucidation of certain important principles of construction is made in a more simple manner than heretofore. By John C. Trautwine, C. E. Illustrated with 690 Engravings from Original Designs. Seventeenth Thousand; Revised and Corrected. Philadelphia: E. Claxton & Company. London: Trübner & Co. 1882.

The publishers of this remarkably and deservedly successful pocket-book have found it necessary to issue another edition of it. It is too well known and valued by the engineering fraternity to require any more from us than a simple announcement of the fact. As in preceding editions, the author has added to the value of this one by important additions.

OTHER PUBLICATIONS RECEIVED.

Proceedings of Meetings held February 1st, 1882, at New York and London, to express sympathy with the Oppressed Jews in Russia. New York: Printed at the Industrial School of the Hebrew Orphan Asylum, 187 and 189 East 76th street, near Third avenue. 1882.

United States Geographical and Geological Survey of the Rocky Mountain Region. J. W. Powell in Charge. Contributions to North American Ethnology. Vol. IV. Washington: Government Print. 1881. 4to, pp. 281. From the Secretary of the Interior.

Summary Statement of the Imports and Exports of the United States for the month ended January 31, 1882, and for the seven months ended the same, compared with the corresponding periods of 1881. Prepared and published by the United States Bureau of Statistics. [Corrected to March 8, 1882].

This department is intended to furnish, for the benefit of all our readers, information on any subject of a scientific or technical character falling within the field of THE MANUFACTURER AND BUILDER. *Any of our readers possessing additional or more correct information than that which we give relating to the questions, are cordially invited to communicate it to us for publication. We also request that all questions or answers be written on separate pieces of paper, and addressed to the Editor.*

QUESTIONS.

(2991) GAS FROM PETROLEUM.—I wish advice as to a convenient plant for making gas, suitable for heating and illumination, from petroleum, on a small scale. The Lowe water-gas process will require too extensive and costly an apparatus for my wants. Can you suggest a process suited to my requirements?—H. P., Philadelphia.

(2992) AMMONIA-SODA PROCESS.—Where can I find an account of the ammonia-soda process? Is it commercially successful?—H. P., Cleveland, O.

(2993) IMPROVED PROCESSES FOR MAKING CHLORINE.—Can you give me an idea of Weldon's process for making chlorine? and of the difference between this process and Deacon's?—H. P., Cleveland, O.

(2994) SAWING STONE WITH SHOT.—I would like to be informed about the sawing of stone with iron shot, which I am told is much better than sand for the purpose. Do you know anything about it from personal knowledge? or can you put me in the way of getting the information?—J. F. D., Nashville, Tenn.

(2995) EXPANSION OF METALS—MELTING POINTS.—I will thank you for a comparative statement of the expansibility of metals. Is there any relation between the expansibility and the melting points of metals?—J. H. H., Portland, Me.

(2996) EXPLOSION OF BLUE-FIRE.—I recently saw an account of a violent explosion, which occurred in New Zealand, from a bucketful of water being thrown, by accident, on a burning mixture containing chlorate of potash, and intended for blue-fire. Too much chlorate had been put in, and for safety the compound was being burned in a stone mortar in the open air. The explosion was heard at a distance of several miles, while the person occasioning it was killed, and much damage was done to property. Could such an explosion arise from hydrogen suddenly liberated by dissociation of water? Did the chlorate alone explode, simply from the shock of contact with the water?—INQUIRER, Philadelphia.

(2997) COMPARATIVE COST OF INCANDESCENT ELECTRIC LAMPS AND COAL GAS.—Have there been any recent, reliable calculations made of the comparative cost of the incandescent electric lights (like Edison's) and common burning gas? I am told there have been considerable improvements made in the electric lights lately, and that now they make a very good showing in point of economy, light for light, as compared with gas?—B. H. B., Cleveland, O.

(2998) TO RID TREES OF INSECTS.—Can you give me any hints as to a safe and expeditious method of ridding trees of insects? I have two shade trees in front of my house that have been for some years so badly infested with the common white caterpillar that they are nearly denuded of leaves in summer, and from being ornamental and useful have been quite an eyesore. Unless I can rid them of these pests, I shall be obliged to cut them down, which I do not want to do.—J. S., Camden, N. J.

(2999) RATE OF EXPANSION OF AIR.—What is the rate of expansion of air, when the pressure is reduced, say from 30 inches of mercury to 29 inches, etc.?—W. B. P., Woodbury, N. J.

(3000) COBALT.—I would like to know something about the value of cobalt, what it is used for, and where it can be had. Information on these points in your useful journal would oblige.—C. T., St. Louis, Mo.

(3001) FORESTS AND CLIMATE.—Have men of science succeeded in positively establishing a connection between forests and rainfall?—E. B. C., Milton, Pa.

(3002) BEARINGS OF SHAFTING.—Is there any rule for distance apart of bearings of shafting?—J. McL., Los Angeles, Cal.

(3003) SPOKE LATHE PROBLEM.—In a spoke lathe, what number of revolutions should the stuff make per minute? and how many feet per minute should it travel endwise, for average size spokes? Are there any better lathes than those on the Blanchard principle?—R. G., Sydney, C. I., Nova Scotia.

(3004) TO MAKE A SCOURING BELT.—Will you please give me full directions for making a scouring belt for polishing spokes. How wide should it be? and at what speed should it run?—R. G., Sydney, C. I., Nova Scotia.

(3005) POLISHING GOLD AND SILVER PLATED GOODS.—Please inform me through your valuable journal how to make an oil polish for polishing and cleaning gold and silver plated goods, brass mountings, nickel, etc.—M. J. D., East Boston, Mass.

(3006) FRENCH DRESSING FOR LADIES' AND CHILDREN'S SHOES.—Please give me a recipe for making a French dressing for ladies' and children's boots, shoes, etc.—something similar to that obtained in the market. Cheapness and good quality are of course desired.—M. J. D., East Boston, Mass.

(3007) PORTABLE INK.—I bought in New York some years ago, at the American Institute Fair, I think, some packages of what was called "portable ink." Each package formed a rectangular parcel about an inch square, and contained about fifty pieces of tissue paper, colored with some black substance. When ink was wanted, a sheet was torn off and covered with a little water, and made enough ink to write a dozen letters. Can you tell me how the paper was prepared? I found the portable ink very handy when traveling.—M. B. L., Pensacola, Fla.

REPLIES.

(2991) GAS FROM PETROLEUM.—As this inquirer has informed us in a personal interview that the ordinary vapor machines, known commonly as "gas machines," will not serve his purpose, we would suggest to him that the process of Mr. Wren, might answer his wants, as it makes a very rich and substantially a permanent gas that may be stored in a gas holder without serious loss by condensation. In the common vapor machines a current of air is drawn over an extended surface of gasolene, and in its passage charges itself mechanically with as much of the oil vapor as is naturally given off at the temperature of evaporation. This quantity is very variable, according as the temperature is high or low, being, in seasons of extreme heat, sometimes so excessive as to cause inconvenience from smoke in burning; while in seasons of extreme cold it is difficult to keep up the evaporation to the extent of affording a good light. The attempt to store up this mixture in gas holders, as in the case of coal gas, introduces the difficulty that the two ingredients of the mixture will separate or stratify after a short time, and condensation speedily follows. The same process takes place, though to a limited extent, in the supply pipes, reaching its maximum in seasons of extreme cold. On account of this tendency, the so-called gas machines are so constructed and operated that the gas is automatically generated as it is needed, and consumed as fast as it is made, and no attempt at storage is made. Other processes for making gas from petroleum involve the gasification of crude petroleum, with the aid of heat, in retorts of various construction, sometimes used in connection with the ordinary coal gas plant to enrich common burning gas, and at others used independently. To the latter class, the Wren process, to which we made reference above, belongs. Without entering into a detailed description of the process, which we could not do satisfactorily without the aid of an engraving, we will explain in a general way that the operation of the Wren process involves the gasification of crude petroleum in a series of connected or communicating retorts. These connected retorts are set in brick-work, and heated as in the operation of making coal gas. A tank of crude petroleum outside the furnace house delivers a regulated stream of crude petroleum into a trapped pipe leading into the retort. This trapped pipe acts at the same time as a safety valve to regulate the pressure on the apparatus, for if from any cause the apparatus, or any part of it, should become choked up, its arrangement is such that the oil ceases to enter the retort. A stand pipe leading from the upper end of the retort, as in the common coal gas plant, passes the petroleum gas into a condenser, where the readily condensable tarry products are accumulated, and from which the finished gas passes on to the gas holder. The size of the apparatus, the number of retorts, dimensions of holder, etc., will depend on the quantity of gas to be supplied. The retort contains a series of communicating chambers, the crude petroleum being vaporized in the first, then passing successively over the heated surfaces of the remaining sections, the object being to effect, as far as this is possible, the permanent gasification of the petroleum by subjecting the vapor issuing from the first chamber to the successive action of highly heated surfaces. The gas made by this process is very rich, and requires to be burned through burners of small orifice, when it yields a high illuminating power without smoking. The process is reported to be in use in a number of towns, factories and other private establishments, and to give satisfactory results on the score of simplicity and economy in operation and quality of product. The address of the owner of the process here described, is W. C. Wren, corner of Jay and Water streets, Brooklyn, N. Y.

(2992) AMMONIA-SODA PROCESS.—Almost any recent work upon chemistry will give the outlines of this process, and an extended description will be found in "Spon's Cyclopædia of Manufacturing Processes." The back numbers of the MANUFACTURER AND BUILDER also contain references to the subject. An interesting review of the process was made by Prof. Dewar before the Chemical Section of the British Association in August, 1879, and may be found in the *Chemical News*, *Nature* and other English journals about that time. As to the question of commercial success, the ammonia-soda process appears to be not only holding its own, but to be steadily growing. On this point, the best testimony that we have is that of Dr. Thomas E. Jenkins, Commissioner to the late Paris Exhibition, from whose report on "Chemical Processes" we make the following extracts relating to the subject: "The ability of this new method of soda manufacture to maintain its existence and successfully compete with the Leblanc process can now be regarded as fully settled. When this process shall have become possessed of a fund of experience as ample as that on which the Leblanc process is based, it is scarcely to be supposed that the latter will be able longer to maintain its existence. The simplicity of the fundamental reaction in the manufacture—the decomposition of common salt in solution by bi-carbonate of ammonia into insoluble bi-carbonate of sodium and chloride of ammonium, and the regeneration of the ammonia by treatment with lime—as contrasted with the cycle of reactions involved in Leblanc's process, attracted the attention of chemists long since. Simple as are the reactions occurring in the process, their economical execution, and especially the avoidance of a loss of the costly reagent ammonia, demanded apparatus of a very much more complicated character and exact adaptation than had hitherto been requisite in soda manufacture." The commercial success of the ammonia-soda industry is universally admitted to be due chiefly to the ingenuity and persistence of M. Solvay, a Belgian manufacturer, who has devoted more than twenty years to the task of perfecting it. The cost of manufacturing ammonia soda in Solvay's works at Nancy, is stated on good authority to be less than $20 per ton. Respecting the amount of production, Dr. Jenkins is our authority for the following estimates: Solvay's process is now in successful operation in the mother establishment at Couillet, Belgium, producing 7,500,000 kilograms (1 kilogram=2.2 pounds) annually; in the French branch at Verangéville-Dombasle, producing 20,000,000 pounds yearly, and which is probably now doubled; and in the English establishments of Brunner, Mond & Co., of Norwich and Sandback, producing 13,000,000 kilograms yearly; making a total in 1878 of 40,500,000 kilograms annually. The soda produced by the ammonia process as developed Solvay, is almost chemically pure, being quite free from caustic soda and containing the merest trace of iron. An analysis of an average commercial product yields over 99½ per cent of pure carbonate. On this score, the soda made by the ammonia process has decided advantages over that made by the Leblanc process. The subject is of so much importance that we may give in our general columns an account of the recent advances in this branch of chemical industry.

(2993) IMPROVED PROCESSES FOR MAKING CHLORINE.—The Weldon process for manufacturing chlorine is an improved process, by which the peroxide of manganese used in the operation is constantly regenerated. It consists substantially in the addition of lime to the residual liquors resulting from the treatment of peroxide of manganese with hydrochloric acid, while a strong current of cold air is blown through the liquid. The hydrate of manganous oxide precipitated by this process, is rapidly oxidized by the abstraction of atmospheric oxygen, and forms calcium manganite (Ca, MnO_3, or CaO, MnO_2), which, having subsided, and the supernatent chloride of calcium (formed in the decomposition of the protochloride of manganese, of which the residual liquor chiefly consists) being run off, is ready for chlorine making afresh, by the addition of hydrochloric acid. This process is repeated indefinitely, and even a change of vessels is not required. The Weldon process is said to be used for the preparation of most of the bleaching powder made in England, and is also widely used in France and other continental countries. The process of Deacon is based upon the idea of dispensing entirely with the chemical operations involved in the decomposition of peroxide of manganese, and effecting the continuous decomposition of hydrochloric acid by the action of a calalytic substance. For this purpose, Deacon conducts the mixture of air and hydrochloric acid as it issues from the sulphate furnaces of the ordinary (Leblanc) soda works, through tubes heated to about 400° C., (=750° Fah.), and filled with porous bricks which have been saturated with sulphate of copper. The result is the decomposition of the hydrochloric acid, the hydrogen uniting with the oxygen of the air to form aqueous vapor, leaving the chlorine free. This decomposition into aqueous vapor and chlorine depends partly upon the interesting property possessed by copper salts of yielding up oxygen to other compounds, while constantly renewing their supply from the air, and partly from the direct decomposition of the hydrochloric acid in presence of air, by contact with porous substances at an elevated temperature. It is only lately that the Deacon process has been so far perfected as to work with regularity and exactness, and possessing as it does the elements of extreme simplicity, it promises to attain to a position of great importance.

(2994) Sawing Stone with Shot.—We know nothing from personal knowledge of the value of iron shot for stone-sawing as compared with sand, never having had the opportunity of witnessing the operation. We have, however, repeatedly been informed on what we regard to be most competent authority, that the shot is decidedly superior to sand in cutting power, and that it has been found remarkably well adapted for the purpose. We are informed, for example, that marble may be cut from three to four times as fast by the use of shot as by the process commonly used for the purpose with the same saws, taking only about half the power in proportion to the quantity sawed. A blade one-quarter of an inch thick is found to be worn away an inch in cutting 48 inches deep in granite, or 250 inches deep in marble. The mud from working is run into catch-pits, and the fine particles of iron thus saved are used for smoothing granite, cutting faster and lasting longer, it is said, than emery. Hard, sharp sand, in being ground to the finest mud, will, it is found, wear away about its own weight of glass; coarse grained emery, about twice its weight; while iron shot, passed through a No. 70 sieve, will, it is affirmed, wear away about fifty times its weight of glass. It is said to be necessary, however, that all journals and rubbing surfaces of the machinery be protected from the shot with unusual care, as it cuts and wears far worse than sand. We do not happen, at the time of writing, to know of the address of parties using this process, though we believe it is in very general use in large establishments all over the country. For our inquirer's purpose, however, it will be sufficient to refer him directly to the inventor of the process, Mr. B. C. Tilghman, 1127 Girard street, Philadelphia, from whom he will be able to obtain much detailed information as to its commercial results that we cannot give.

(2995) Expansion of Metals—Melting Points.—We may state for the information of this inquirer, that the melting points of many of the metals are quite uncertain, on account of the difficulty of determining the same with accuracy. Different authorities, therefore, give different values. The table appended is from Trautwine, and gives the mean values of the best authorities. In a general way, it is true that those metals having a comparatively low melting point are also the more expansible; but there are so many exceptions to the statement that it must not be taken as a general rule. Thus, silver, the melting point of which is above 1,800° Fah., has a higher coefficient of expansion than bismuth, which melts at about 500° Fah.; while zinc, the most expansible of all metals, has its melting point at about 700° Fah., or 200° above that of bismuth. The table will tell its own story:

Approximate Expansion of Solids by Heat, and their Melting Points, Fah.°—(Trautwine).

Metal.	Expansion for 1°: 1 Part in	⅛ Inch in	Melting point.
Antimony	166,500	1,722 feet	955
Cast iron	162,000	1,688 "	1,920 to 2,800
Steel	151,200	1,575 "	
" blistered	159,840	1,665 "	
" untempered	167,400	1,744 "	2,370 to 2,550
" temp'd, yellow	131,400	1,369 "	
" hardened	146,880	1,530 "	
" annealed	147,600	1,537 "	
Iron, rolled	149,940	1,562 "	
" soft, forged	147,420	1,536 "	3,000 to 3,500
" wire	146,340	1,524 "	
Bismuth	129,600	1,350 "	506
Gold, annealed	123,120	1,282 "	2,016
Copper	104,400	1,088 "	2,000
Brass	99,740	1,018 "	1,873
" wire	94,140	981 "	...
Silver	95,040	990 "	1,861
Tin	87,840	915 "	442
Lead	63,180	658 "	612
Pewter	78,840	821 "	...
Zinc	61,920	645 "	680 to 772

(2996) Explosion of Blue-Fire.—It appears to us that the most rational method of accounting for the explosion reported by "Inquirer," would be to suppose that only a small quantity of the water thrown by the person who tried to extinguish the fire, reached the burning mass. Under such circumstances, the contact of the water, in a more or less finely sprayed condition, with the intensely heated and incandescent mass, would cause it to be converted almost instantaneously into steam, and the shock produced by the sudden expansion of the steam, would be sufficient to induce the violent explosion of the ignited mass. The composition contains in itself all the elements necessary to explode with violence, when the conditions favoring it are present; and in the case reported, where the materials were in a state of intense combustion, it only required the mechanical shock of the suddenly expanding water spray to cause its violent explosion. While there would be no difficulty in accounting for the explosion under the above named conditions, it is not necessary to suppose that only a small quantity of water reached the ignited mass, as the result would almost certainly have been the same had all the water reached it; for the *first portions* of the water that touched the intensely heated mass would have done the mischief, and the explosion would have followed simultaneously with the instant of contact. We may add in a general way, that all mixtures containing potassium chlorate are highly dangerous, and the most innocent causes often bring about serious accidents with it, as every chemist and pharmacist of experience will be able to testify.

(2997) Comparative Cost of Incandescent Electric Lamps and Coal Gas.—In answer to this inquirer, we may state that Mr. Swan, the inventor of an incandescent electric lamp very similar to Mr. Edison's light, recently gave some particulars before the London Royal Institution as to the comparative cost of incandescent lights and gas, which make a very good showing for the former, and which, so far as we can judge, appear to be reliable. They are doubtless approximately true. He said the cost of light by electric incandescence might be compared with the cost of gas light in this way: Two hundredweight of coal produced 1,000 cubic feet of gas, and this quantity of gas, of the quality called 15-candle gas, would produce 3,000 candle-light for one hour. But besides the product of gas, the coal yielded certain by-products of almost equal value. He would, therefore, take it that they had in effect 1,000 feet of gas from one hundredweight of coal, instead of from two, as was actually the case. The one hundredweight of coal would give 50 horse-power for one hour. Experiments showed that they could obtain, through the medium of incandescent lamps, at least 200 candle-light per horse-power per hour. But as there was waste in the conversion of motive power into electricity, and also in the conducting wires, he made a liberal deduction of 25 per cent, and took only 150 candle-light as the net available power of one horse-power. For 50 horse-power, the product of one hundredweight of coal, they had then 7,500 candle-light as against 3,000 candle-light from 1,000 feet of gas. There remained, however, an allowance to be made to cover the cost of the renewal of lamps. Whether by the method of multiple arc, which required the multiplication of electrical stations, or by means of the simple series or of secondary batteries connected with each other from house to house in single series, the lamps being fed from these in multiple arc, he was satisfied that comparatively with the distribution of gas, the distribution of electricity was sufficiently economical to permit of its practical application on a large scale.

(2998) To Rid Trees of Insects.—We have gone through the same experience that our correspondent relates, having had serious trouble with some shade trees that became infested with caterpillars, which year after year would reappear and almost denude them of their leaves. We determined this year to try to rid them of the pests, to which end we prepared a wash of about a pint of soft soap in about two gallons of water, to which was added about four ounces of carbolic acid, which last was thoroughly stirred in. With this wash the limbs and trunks of the trees were thoroughly wetted, after they were trimmed. The object to be accomplished is to kill the eggs that are laid in the bark, and which hatch out as soon as the weather becomes continuously warm. Carbolic acid, which is a poison to the lower forms of life, is the best agent that can be used for the purpose, but would be apt to cause injury to the trees if applied directly, hence the use of a soap solution as a dilucent and carrier of the substance. We have faith that this application, properly put on, will effectually remedy the evil.

(2999) Rate of Expansion of Air.—We have given the correct answer to this question in several different forms in former numbers of this journal. The volume of a gas (like the air, which will not condense save under an enormous pressure) is inversely proportional to the pressure under which it is placed; so that a volume of air occupying a space of 1 cubic foot under a pressure of 30 inches of mercury, will expand, when the pressure is reduced to 29 inches, and occupy a space one-29th greater than its former volume. The mathematical expression of this law is as follows: $V : v :: p : P$, where V equals the original volume under 30 inches; v, the changed volume; P, the pressure corresponding to the original volume; and p, the changed pressure. From the above formula, then

$$v = \frac{P\,V}{p} \text{ or } v = \frac{30 \times 1}{29} = 1.034 \text{ cubic feet.}$$

1 cubic foot of air, therefore, becomes 1.034 cubic feet when the pressure is reduced from 30 inches to 29 inches of mercury.

(3000) Cobalt.—Various compounds of the metal cobalt have long been employed in the arts for coloring glass and porcelain, enameling and glazing, for oil and water colors, and the like. The metal itself is not used in the arts to any extent. Its ores are almost exclusively found associated with nickel in small proportion, and the separation of the metals is expensive and tedious. Nickel, which is much the more abundant metal, possesses all the properties that would make cobalt useful in the metallic state. The only suggestion made to utilize it is for plating, where nickel, on account of its cheapness and the beauty of its products, answers every purpose most satisfactorily. We may refer this inquirer for information as to the commercial value of cobalt, to Mr. Joseph Wharton, American Nickel Works, Camden, N. J. The only cobalt manufactured in the United States, so far as we know, is made at these works. We may, if the opportunity occurs, describe some of the most important technical uses of cobalt compounds in the general columns of our journal.

(3001) Forests and Climate.—That there is a positive and important connection between the abundance and absence of forests in a given region and the quantity and character of its rainfall, is now almost universally admitted, and this inquirer will find the statement, and the grounds upon which it is based, in every important work on physical geography. An excellent presentation of the subject will be found in Marsh's "Man and Nature," which will be found in every library. The most important recent investigations on the subject are those of Sir Gustav Wex, an Austrian investigator, who has made many observations and researches which tend to prove that the water in rivers and streams is gradually diminishing. These investigations have been translated and published by the Engineer's Department of the United States Army. See also an admirably written and forcible article on the "Climatic Influence of Vegetation," by Dr. F. L. Oswald, published in the *Popular Science Monthly* for August, 1877, which contains a most eloquent plea for our forests.

(3002) Bearings of Shafting.—We know of no rule to govern this case. There are, however, several safe working formulæ. We add the following table on the authority of Francis, of the *greatest admissable distances* between the bearings of continuous shafts, subject to no transverse strain except from their own weight:

Diameter of Shaft in Inches.	Distance bet. Bearings in Feet—Wrought Iron.	Steel.
2	15.46	15.89
3	17.70	18.19
4	19.48	20.02
5	20.99	21.57
6	22.30	22.92
7	23.48	24.13
8	24.55	25.23
9	25.53	26.24

In practice, long shafts are scarcely ever entirely free from transverse strains; however, in the parts of long lines which have no pulleys or gears with the couplings near the bearings, the intervals between the bearings may approach the distances given in the foregoing table.

(3003) Spoke Lathe Problem.—A Blanchard spoke lathe, as improved by the Rollstone Machine Co., should turn from 1,000 to 1,200 1-inch spokes per ten hours, the driving shaft making from 550 to 600 turns per minute, with a pulley 11 inches diameter and 4¾ inches face, and takes from 3 to 4 horse-power to drive it; weighs 1,600 pounds, and costs $350. The machine is geared so that the speed of the cutters and spoke work to the best advantage. Not having one at hand, we cannot calculate up the speed of the cutter and spoke. If our correspondent bought one, he would find it do the best work with the driving shaft making 550 to 600 turns, and could not vary the velocity ratio of the cutters or material. The improved Blanchard spoke lathe above referred to is the best of this class of machines. All are constructed on the Blanchard principle. J. A. Fay & Co.'s lathe has a capacity of 600 to 1,000 spokes per ten hours, according to size. It takes about 5 horse-power to drive the machine thoroughly up to its capacity. The slower the feed the less power needed. The machine weighs 2,500 pounds boxed, and costs $400. The spoke makes 120 revolutions per minute, and the lathe is supposed to turn from ¾ to 1 inch at each revolution of the spoke. The cutter-head makes 2,500 turns per minute.

(3004) To Make a Scouring Belt.—Take a 4-inch belt, cover with glue and very finely broken, evenly sifted, powdered glass, and run about 4,000 feet per minute. If not convenient to get powdered glass, very finely sifted, evenly sized, sharp, hard river sand may be made to answer as a substitute. The finer the material in either case the better.

(3005) Polishing Gold and Silver Plated Goods.—We endeavor always to reply as intelligently as possible to questions asked, but hardly know how to reply to this one. Oil is used in connection with emery and rotten stone in polishing metals, and if this is what he means by an "oil polish," the following statements may be of use to him: The highest possible glossy finish is put on metallic objects by what is known technically as "black polish," which is done in the following manner: First, a fine file is used; this is followed by water-of-Ayr (Scotch) stone, this by fine emery paper, and the highest possible finish is put on by following this with a rubbing with a soft (pine) stick and rotten stone and oil. The work is finally rubbed off with a soft rag and chalk, or sometimes with wash-leather. Where fine grain is more essential than high gloss, as is the case with all ordinary work, emery paper and oil are found sufficient, the excess of oil being wiped off with a soft rag and chalk. In all cases where a very high polish is desired, it is found expedient to put on the finished surface a coating of shellac varnish or lacquer, as without it the metal soon tarnishes on exposure to the air. Plated stuff should only be polished with chamois and chalk, or other substance that will not cut or scratch.

(3006) French Dressing for Ladies' and Children's Shoes.—This question was answered, as nearly as we could, in our February issue. See answer to Query 2952.

(3007) Portable Ink.—The aniline colors, which possess great tinctorial powers, can be conveniently used in the preparation of a portable ink such as this inquirer describes. We do not know how that which he speaks of was made, but if he will saturate white tissue paper with an aniline violet, or with aniline black, by dipping the sheets into a saturated alcoholic solution of these colors, then drying and packing them in suitable parcels, he will have a portable ink, either violet or black, that will behave just as that he describes.

THE MANUFACTURER AND BUILDER.

A PRACTICAL JOURNAL OF INDUSTRIAL PROGRESS.

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A Double Fire-Proof Roof.

The most exposed portion of a building, and that which is consequently the most liable to be endangered by the falling of sparks and cinders in the event of a neighboring fire, is the roof. A large proportion of the destruction of property in cases of extensive conflagrations, as all our readers will be aware, may be justly ascribed to the firing of roofs in this manner. It needs no argument, then, to support the assertion that a building that has a thoroughly reliable fire-proof roof, no matter how defective its construction as regards the fire hazard in other respects, being very effectively protected against fire from without, is practically free from a large proportion of the fire dangers that arise.

We have previously had occasion to refer to the excellent fire-proof roofing system of the Anglo-American Roofing Company, of 22 Cliff street, this city; and in view of the great interest now being taken in everything relating to fire-proof construction, and also in view of the fact that this company is constantly improving the character and quality of its roofing, we are induced to invite renewed attention to its products, even at the risk of covering ground already gone over.

The roof here referred to is made of wrought-iron shingles, each $8^{7}/_{16} \times 16$ inches in dimensions, and of peculiar shape, so that when laid, the edges and corrugations forming the joint are covered by those of the adjacent shingles. When completed, the result of the peculiar method of jointure is to produce in effect a double fire and storm proof roof. The work of laying requires no special skill, and can be done satisfactorily by any carpenter. They are either given a coating (on both sides) of a special metallic paint before laying down, or may be protected from the weather by a special process called "calamining," which coats them with an alloy of an incorrodible metal.

The manner of laying down these shingles will be fully understood from the following description, reference being had to Fig. 2: First draw the line A A at the correct distance from the eaves, to lay on it the upper edges of the eaves' course shingles. Obtain the center of this line, and draw from it the perpendicular line C C to the ridge of the roof. This line must be at exact right angles with the line A A and with the eaves of the roof. Then "step" off with a pair of dividers, or with a gauge constructed for the purpose, $8^{7}/_{16}$ inches each way from the line C C, and draw the perpendicular lines 1, 2, 3, 4, 5, 6, etc., at that distance apart, and exactly parallel with the line C C. These lines will show the exact width of the shingles; also draw horizontal lines parallel with the line A A, $6\frac{7}{8}$ inches apart, on which to lay upper edges of each horizontal series. A pencil and straight-edge are the best to draw the lines with. Shingle-lath or slats are always preferable to close sheathing for laying these shingles on. These slats should be laid $6\frac{7}{8}$ inches apart, from center to center. Commence laying the "shorts" or eaves course of shingles from the line C C, taking

Fig. 1.—The Metallic Shingles Applied to Hip Roof and Gables.

care to have the upper edges come exactly up to the line A A; of course this line A A can be drawn so as to allow the shingles to project over the eaves as much as is desired. In laying the eaves course, and indeed all succeeding courses, care should be taken to keep the sides of each shingle straight with the perpendicular lines, and also to keep the slots in the sides of the shingles exactly opposite each other. Commence to lay the full size shingles at the line C C,

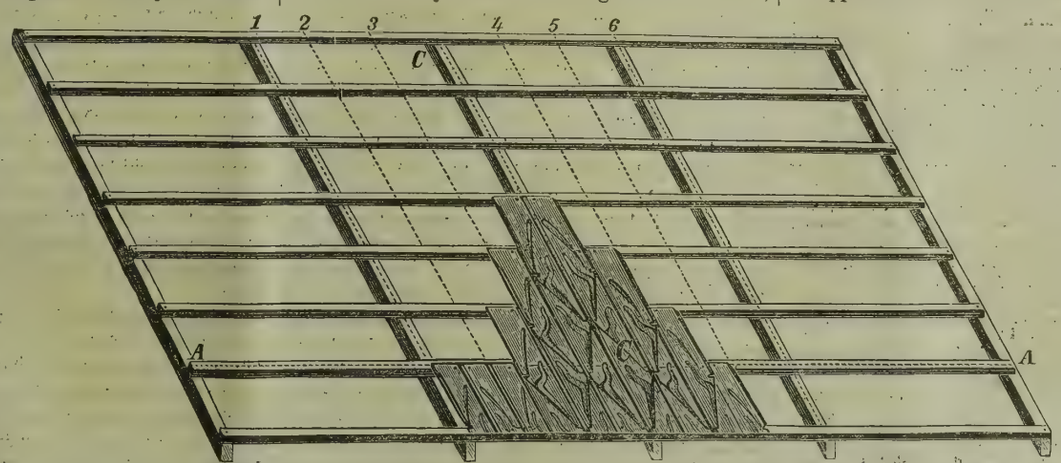

Fig. 2.—METHOD OF LAYING THE METALLIC SHINGLES.

placing the central rib or corrugation D exactly over the line. If the lines are drawn correctly, the nail-holes in the shingles will usually fit over each other; but this is not of so much importance as it is to have the slots in the sides of the shingles exactly opposite each other and the points that are introduced in them to completely fill up the slots. This is important, and if ordinary care is taken in laying them no trouble will be had in making the points closely fill every slot. Should it sometimes happen that the nail-hole in the under shingle does not exactly fit under the nail-hole in the upper shingle, it will be found that the nail can be easily driven through the shingle. In finishing at the ridge of roofs, bend each shingle of the ridge course over so as to lap on the opposite side of the roof about two inches, nailing in the lap. In laying them on hip roofs, trim the sides or the ends of the shingles to the same angle as the hip, and bend them over the corner so as to lap on the opposite side of the roof (as at the ridge), nailing them in the lap. In laying them along valleys, trim them to the angle of the valley, and use a sheet of tin or other metal the same as with slates or wood shingles. The shingles can always be cut to the desired shapes, to make them come out even at the edge or gable of the roof, with a pair of ordinary tinner's hand shears or "snips." When the shingles are laid, the ridge and corners of hips should be finished with a calamined iron ridge cap. The shingles require about the same incline as ordinary slates or wood shingles, say at least three inches to the foot.

The general advantages of this form of roof on the score of security have already been referred to. The special advantages it possesses over other roofing materials are more elaborately stated by the manufacturers substantially as follows: As compared with slates, 1st, they are much lighter. Being less than one-fourth the weight, they allow the use of much lighter roof timbers, making a considerable saving and producing much less strain on the walls of a building. They weigh only about 125 pounds to the square when laid. This item of weight on large roofs is an important one, and makes the metallic shingles the cheaper roofing to use, even in localities where the apparent cost of the slates is much less. 2d. They are made of wrought metal, and readily adapt themselves to the formation of roofs. By their construction, they lay much tighter than slates can possibly be made to, and are consequently more thoroughly storm-proof. They will not crack by the action of frost, or the nail-holes be worn from any cause, so as to let the shingles loose from the roof. Slates are open to both these objections. 3d. They are more perfectly fire-proof. If slates are heated by a fire on an adjoining building, they crack and fly in pieces, leaving the building exposed. Their tendency to break under these circumstances is increased by water being thrown on them while hot, whereas the metallic shingles cool quickly without breaking, if water is thrown on them, when heated by fires, thus continuing the protection to the building.

As compared with ordinary tin roofs: 1st. They avoid all dangers of leaks by expansion and contrac

tion of the metal, as each shingle is laid and fastened by itself, and is at liberty to expand or contract without in the least affecting the qualities of the roof. 2d. They require no solder in laying, and, as in the comparison with slates, they are more perfectly protected against damage by neighboring fires, as solder will melt when exposed to any considerable degree of heat, and tin sheets warp, thus leaving the building exposed. 3d. They are made of much thicker material, besides being laid double.

The sources of leaks in a tin roof come principally from three causes: 1st. On a pitch roof it is very difficult to properly solder the seams, and when the metal expands and contracts by the varying temperature, they are liable to break away. 2d. Corrosion takes place frequently from the under side, where the tin is not protected by paint, and as the tin commonly used for roofing purposes is very light, this rust destroys the roof in a short time. 3d. The tin is very easily pierced by any of those unavoidable accidents that so frequently occur to roofs. Experience has proved that none of these objections can be urged against the metallic shingles.

Compared with wood shingles, they do not shrink or warp; the tendency of wood shingles to do both of these is a prolific source of trouble with the ordinary shingle roof. Furthermore, the common shingle roof offers the best means that could be devised for the spread of a fire, while the iron shingle is fire-proof.

As compared with other forms of iron roofs, the convenience, ease of laying, strength, and permanence of the iron shingle roof are claimed to be decided advantages.

The small sketch (Fig. 1) shows the iron shingle being applied to a hip roof. An idea of its handsome appearance will be obtained from the finished portion of the work.

The Manufacturer and Builder.

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Destructive Legislation.

On the 15th of May, the national House of Representatives passed, by a decisive majority, a bill, which, should it by any misfortune become a law, would practically put an end to the protection which the patent laws now afford to the owners of property in patents, and would in the natural course of things do away entirely with the necessity for the patent office, and with inventors. The inventor, finding himself deprived of the prospect of getting some substantial return for the fruits of his intellectual toil, would naturally cease inventing, for the stimulus and inspiration of his work would be lacking—he would scarcely care to sow that strangers might reap.

The text of this extraordinary and iniquitous measure is as follows: No action for damages, or proceedings in equity, shall be sustained, nor shall the party be held liable under sections 4,919 or 4,921 of the Revised Statutes of the United States, for the use of any patented article or device, when it shall appear on the trial that the defendant in such action or proceeding purchased said article for a valuable consideration in the open market.

It is alleged in defence of this extraordinary measure, that, as the law now stands, innocent persons who buy articles in the open market, pay a good price for them, and without any intention of defrauding the inventor of his rights, are liable to be called upon to pay royalties to the inventor of whose existence they had no knowledge; that this frequently works great hardship, and is an evil that should be remedied. It is true that here is a wrong that should be righted, if possible; but is it right to remedy one wrong by creating a greater one? Is it right to protect the purchaser of stolen goods at the expense of the real owner? A man's invention is as much his property in law as his house, his lands or his horse, and the law most properly and justly recognizes no distinction between them. It is a hardship for the innocent buyer of a stolen horse, or of a fraudulent or worthless deed for a house or land, to be obliged to surrender his purchase to the rightful owner; but who is there who reads this who would not say it would be a greater hardship to the rightful owner if the law enabled the holder of his property to say to him: "I bought this horse, or this land, in open market for a valuable consideration; it is mine." Would not such a state of things be putting a premium upon theft? Would it not call organized robbery into existence everywhere by legalizing the receiving of stolen goods? Yet this is in substance precisely what the bill passed by the House of Representatives would do with the rights and property of inventors.

Should this extraordinary measure become a law, it would only be necessary for one who felt disposed to use a patented invention without paying its owner for the right to use his property, to have one part made here, another there, a third elsewhere, and so on, paying for each a valuable consideration in the open market; to put the parts together, and point for the legalization of his robbery to the law, should the inventor venture to protest. There are thousands of unprincipled men, not burdened with such a thing as a conscience, and not particular as to the moral obliquity of any enterprise they engage in, provided only that it pays, who would hail the passage of such a law as this one with delight, and organized piracy of patent inventions would become a business.

To take a familiar case for comparison: The national government, with all the vast resources at its command, finds it impossible to put down the business of illicit distilling. How, then, shall the inventor, single handed and unaided, ferret out those who steal his invention, and dispose of it, through secret channels and mysterious agents all over the country? What chance has he against the organized bands of robbers, which this law would call into existence, when the buyer and user of his stolen property has only to show that he bought it openly and paid for it? He need not know the seller, nor would it be necessary for him even to name him.

These are some of the conclusions that may legitimately be drawn from a careful reading of the text of the bill that passed the House of Representatives. It has, fortunately, yet to run the gauntlet of the Senate, where there is good reason to hope it will be killed. Should it become a law, with the President's approval, some are sanguine enough to anticipate that it would be declared unconstitutional by the Supreme Court. This possibility we do not care to entertain.

We must confess that our estimate of the mental caliber and statesmanship of the members of Congress, never a very exalted one, is not raised to positive admiration by the knowledge that the bill here referred to, passed the House by a majority of considerably over one hundred. At nearly every session of Congress, some back-woods Solon, one of whose constituents has probably been tripped up on a gross of patent "hog rings," fumes about the oppression of the patent laws and the necessity of reform. It is time that this sort of nonsense was made an end of. If any one should be aware of the fact that the immense development of the manufacturing arts has been due chiefly to the wise and liberal action of our patent laws, in fostering invention and encouraging inventors to invent, by holding out the promise of protection and reward, it should surely be he who aspires to exercise the eminent functions of a representative and legislator; and yet it is questionable if among the three hundred and more representatives in Congress, a quarter of the number have any conception of the vast detriment to the country at large which their (let us charitably hope) stupid act of May 15th would inflict should it by any mischance become a law.

That its importance is not underestimated by those best qualified to judge of its mischievous and destructive effects, is shown by the almost universal condemnation it has received in the technical journals; and it is to the lasting credit of the venerable Franklin Institute to note how promptly its members vindicated, by their decisive action, its eminent reputation as an institution for "the promotion of the mechanic arts." At a special meeting of this body, held on the 24th of May, and called for the purpose of considering this piece of destructive legislation, the following preamble and resolutions were unanimously passed, and a copy was sent to the President of the Senate, the Speaker of the House, and to each member of Congress; and a committee was appointed to proceed to Washington to make the protest of the Institute against the bill. The resolutions state the case forcibly and well;

"*Whereas*, By vote of the House of Representatives of the United States, taken on the 15th day of May, 1882, a bill was passed to amend the United States patent laws, which amendment takes away almost the entire protection granted by letters-patent to property acquired by invention, and in effect legalizes theft; and

"*Whereas*, It is manifest that any such enactment as will relieve the possessor of a fraudulently made article from all liability as a party to the infringement, will render the protection heretofore guaranteed by letters-patent, as utterly inadequate as though no patent existed; and

"*Whereas*, The unparalleled advances that have been made by this nation in every department of science and industry are due solely and unquestionably to the wise provisions of our patent laws, and all legislation that in any degree detracts from the protection now afforded to inventors, would paralyze all the industries which by protected ingenuity have become monuments of American progress, and sources of incalculable wealth to the nation; therefore be it

"*Resolved*, That it is the sense of the Franklin Institute, of the State of Pennsylvania, for the promotion of mechanic arts, that the amendment to section 4,919 of the Revised Statutes, relating to the recovery of damages for the infringement of patents, which passed the House of Representatives May 15th, 1882, is a violation of the rights ensured to the holders of patents under the laws of the United States; is a deprivation of the remedies which are essential to the maintenance of those rights; is a breach of the contract with patentees made by the laws relating to patents; is injurious to the interests of inventors and patentees, with no compensating advantages to any other honest persons; and is destructive of the system of patents in the United States, which has done more than any other one thing for the promotion of the mechanic arts and the advancement of the material interests of the country."

The Benefits of our Present Patent System.

Apropos of the foregoing comments on the proposed amendment of the patent laws, it may not be amiss to devote a few remarks to the correction of what we believe to be a serious popular misapprehension. We frequently hear the remark passed that Americans are a people of exceptionally great ingenuity, that the inventive faculty is highly developed in us as a people, etc.; and if one making this assertion were called upon to prove it, he would doubtless, after having recovered from the surprise which the raising of the doubt would occasion, point to the universal introduction of labor-saving machinery in every branch of the arts and manufactures, to which much of our unexampled progress as a nation must be ascribed; and to the enormous number of inventions issued weekly from the patent office, as sufficient evidence to support the assertion.

It strikes us, however, that there is a fallacy, and a serious one, involved in this argument, and that those who use it with the satisfied conviction that it is unanswerable, are really confounding effect with cause.

We do not wish to be understood as underrating the inventive faculty of our people, or as denying that they have this faculty highly developed; but what we do wish to emphasize, is the assertion that there are people of many other nationalities, who, under circumstances as favorable to the development and exercise of the inventive faculty as those that have ruled in this country, would have made perhaps as good use of their opportunities as we have done, and achieved quite as high a reputation as an inventive and ingenious people.

We assert, further, that the one thing that, more than any other, has developed the inventive faculty of our people, and encouraged its exercise, has been the *liberal patent system* of the United States, which, with its moderate fees for obtaining letters-patent, and the protection which its wisely framed provisions have accorded to the inventor, has stimulated the ambition of our people to make improvements in the arts and manufactures. By placing prominently before them these incentives—reasonable fees for patents and ample protection for their rights by the law—we have at once added to the hope of substantial reward, the needful stimulus and inspiration to make of our people a nation of inventors.

Let those who have hitherto used the argument that we have endeavored to prove to be fallacious, think the matter over, in the light of these comments, and we are satisfied that they will agree with us that the liberal provisions of our patent laws are to be largely credited with having nourished, fostered and encouraged the growth, development and exercise of the inventive faculties of our people; and they are entitled to be credited also with much of the material benefit that has followed upon the introduction of the myriads of improvements in the arts and manufactures, which have done so much to make us rich and powerful as a nation.

It is to be regretted that many of those who are supposed to represent the people in the national legislature fail to perceive these things. If they did, there would be less disposition in Congress to tinker with the patent system. As it stands, it has proved of inestimable benefit to the country. If anything is to be done towards modifying it, the change should be in the direction of still greater liberality in the matter of fees, and still more protection to the inventor.

The legislators of other nations are not so obtuse to the excellence of our patent system as some of our would-be reformers at home, as we have once before had occasion to point out; and the best proof of this is afforded by the fact that every modification of the patent systems by European countries that has of late been made, has been in the direction of a closer assimilation with the liberal provisions of our own. We repeat our warning some years ago, to the tinkerers with our patent laws, "Let well enough alone."

Darwin.

Since our last issue, the world has lost the greatest man this century has produced—the man who has stamped the impress of his life-work deeper than any other upon the thought of his time, and who will doubtless be ranked by after generations with the most illustrious.

Darwin was not, as is popularly believed, the originator of the theory of evolution; but he was the first to present it to the world in a form to command the attention and respectful consideration of naturalists. That he succeeded where others had failed is due to several causes. His work came at a time when the world of science was prepared to receive it, and his wonderful faculty of minute and accurate observation, aided by his equally wonderful industry, enabled him to fortify the theory which he advanced, with such a wealth of new and remarkable facts, that the acceptance of his views, though it was not without bitter opposition, soon became general. The publication of his great work on "The Origin of Species" initiated as profound a revolution in the study of natural history, as in its time the announcement of the heliocentric theory of Copernicus created in the science of astronomy. Its effects have been even more far-reaching, for the theory of evolution, involving as it does the question of the origin of the human race, trenched so decidedly upon the domain which the theologians had hitherto deemed their exclusive property, and brushed aside with profane hand so many of the childish though venerable traditions respecting the origin of living races of animals and plants, and especially of mankind, which had hitherto been held as sacred, that the audacious iconoclast could not fail to have all the vials of wrath known to theologians poured out upon his devoted head.

As has been the case in every controversy between theology and science, the latter triumphed, and victory finally perched on the banners of the evolutionists. What the theologians at first denounced and execrated as incompatible with revealed religion—subversive of all religious belief, atheistical, etc., etc., through the entire gamut of emphasis, they have finally, as the truth made its way in spite of them, learned to tolerate, and, in the case of some of the wiser heads of their party, even to embrace. And one of the most singular and instructive lessons for the philosopher and student, is that which is afforded by the present conciliatory attitude of the theological party toward the views of the origin of the diversities in living races, with which the name of Darwin is identified, as contrasted with the execretion and abhorrence with which they were referred to less than ten years ago. The explanation of this change of front is not difficult to assign. Then the theory of evolution was struggling for recognition, and was encountering strong opposition among the ranks of the naturalists themselves. Such eminent men as Agassiz, whose life-work was identified with the support of the old Cuvierian view of the independent creation of each specific living form, could not, or would not, lend ear to the new doctrine, and threw the whole weight of their great influence against it. The younger generation of naturalists, just rising into prominence, and unfettered by the lifetime of devotion to ancient theories which warped the judgment or hampered the freedom of action of their elders, were able to appreciate the true value of the new departure initiated by the publication of "The Origin of Species." They accepted it with enthusiasm, added to and extended the list of causes that have been operative in preserving and perpetuating species and varieties, gave an impulse to the study of natural history, that advanced it farther within the past two decades than in a previous century, and so strengthened and demonstrated the truth of the doctrine first formulated in reasonable form by Darwin, of the origin of the present forms of animal and vegetable life from preëxisting forms, that to-day its acceptance among naturalists is all but universal.

To-day, he who less than ten years ago was the recipient of more theological abuse and villification than any man who has lived since Judas Iscariot, rests in honored sepulcher within the sacred precincts of Westminster Abbey. This fact alone speaks volumes for the change of sentiment that has taken place in the very stronghold of orthodoxy.

It is highly interesting, and not a little amusing, to one who has followed this latest conflict of theology with science through its several phases of contempt, execration, abhorrence, toleration, and final acceptance, to learn that eminent dignitaries of the English Church, in commenting on the life and work of the great apostle of evolution, have made the discovery that "that the theory of evolution, at least in its most important aspects, has come to be recognized as not inconsistent with creation or revelation." Even Dr. McCosh, of Princeton, of whom we had occasion to speak some time ago in connection with his effort to cast the responsibility for the defective sewerage of the college buildings, and its terrible consequences, upon Providence, has been so far persuaded as to modestly acknowledge that "men of large minds" (meaning thereby, obviously, McCosh and a few others) "have found nothing inconsistent in the assumption that God works in a secondary way through these operations of nature." This sort of talk, and the utterances above referred to, appear to indicate that the leaders of the theological party, seeing the folly of further opposition to the theory of evolution, are endeavoring to let themselves down as easy as possible. Were it not for the eminent respectability of the gentlemen in question, we would be tempted to say that the only interest that men of science take in their sayings and doings respecting this subject, is due to the spectacle it affords, of so many "men of large minds" industriously engaged in "eating crow."

Dean Bros'. Steam Pumps.

The accompanying engravings represent several styles of steam pumps made at the Dean Bros. Steam Pump Works, Indianapolis, Ind., and which, while embodying the features that have come to be recognized as standard in their respective classes by advanced manufacturers, represent likewise certain special features which add to their serviceability and give them the distinctive characteristics that have earned for them a high reputation.

The manufacturers of the Dean Bros. Steam Pump Works embrace pumping machinery of many varieties. Their line of direct-acting pumps is complete and extensive, both as to styles and sizes, embracing the latest improvements in this class of machinery. They claim to have, also, the largest list of crank-pump patterns of any makers in the country; and in addition to steam pumps for general purposes, they are prepared to construct water-works' pumping engines, condensing or non-condensing, single, duplex or compound; they manufacture likewise a number of specialties, such as combined air pumps and condensers, crank air compressors, hydraulic pumps, etc. The makers claim for all their products, that they are made in the most careful and thorough manner as regards workmanship and materials. The parts are made interchangeable, following, in this respect, the system recognized as indispensable by all leading mechanical works. The piston rods are of steel, the valve seats and glands of solid composition, and both steam and water cylinders are fitted with adjustable packing. The action of the pumps is so simple as to be easily understood by the mechanic of ordinary intelligence and experience.

The engraving, Fig. 1, represents one of the Dean Bros. direct-acting pumps of the style manufactured for boiler-feeding. The special advantages of these direct-acting pumps are stated by the makers as follows: They have no dead center, and will start automatically at any point of the stroke; they will discharge the water of condensation; they have simple and positive steam valves; and they will run without shock or jar, fast or slow.

The large engraving, Fig. 2, represents the form of Dean pump designed for fire protection or water supply. It has an 18-inch steam cylinder, 12-inch water cylinder, and 24-inch stroke; can be run to 150 strokes per minute, with a maximum capacity of 1,500 gallons discharge per minute.

Fig. 3 is a view of a style of vertical pump made by the same manufacturers, and intended for service in deep wells or mines, and places where it is inconvenient or impossible to use the horizontal style of pump. It has no dead point, always starting when steam is turned on. The pump is fastened to a cross timber in the well, and is connected with the frame of the steam cylinder by two vertical rods. The pump is double-acting, and, therefore, will deliver a continuous stream. The valves can be quickly taken out. These pumps will work without shock or jar, as the amount of steam for the downward or upward stroke can be governed by the engineer. There being adjustable valves at both ends of the steam cylinder, a perfectly uniform motion is produced without regard to the weight of the reciprocating parts. The dimensions of these pumps depend on the hight the water has to be forced, and other varying conditions. When desired, the makers furnish the regular Cornish pattern, consisting of a single-acting plunger, which they recommend as best adapted for very deep wells or mines.

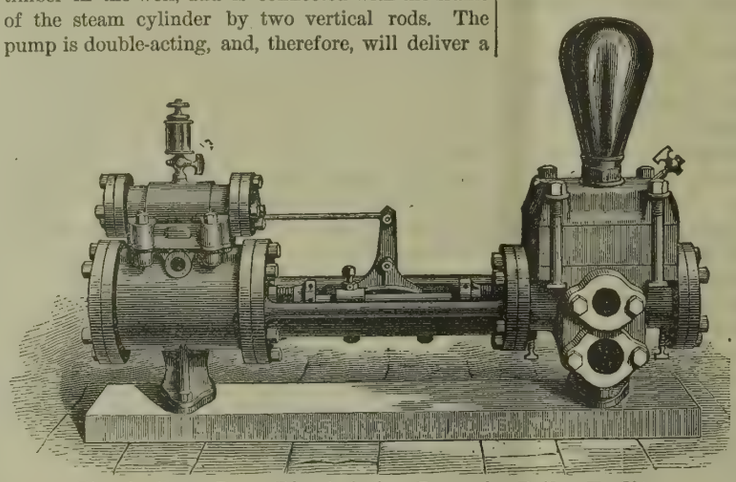


Fig. 1.—Dean Bros. Direct-Acting Pump for Boiler-Feeding.

We have selected from the fully illustrated catalogue of these makers the foregoing examples as representations in a general way of their products. For additional information and details respecting specialties, we refer inquirers directly to the Dean Bros. Steam Pump Works, corner Madison avenue and Ray street, Indianapolis, Ind.

The increasing business of the Dean Bros. establishment has lately necessitated a considerable enlargement of the works, the new addition consisting of an extension to the machine shop, which now has a total length of 350 feet, and a fine building for offices, drafting-room, etc.

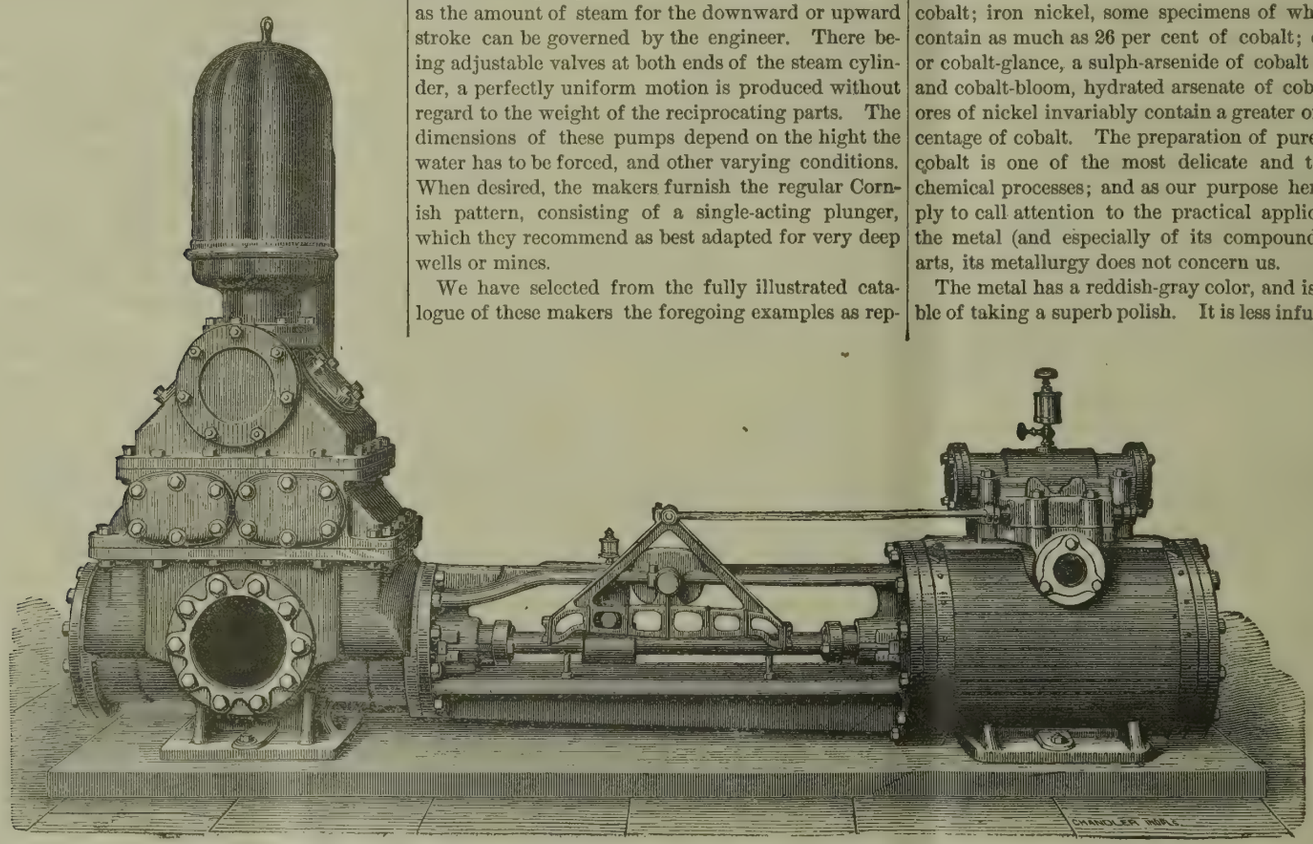


Fig. 2.—DEAN BROS. PUMP FOR FIRE PROTECTION OR WATER SUPPLY.

LEATHERETTE.—The material, known as leatherette, is being brought into use in numerous mechanical and ornamental applications. It is so perfect an imitation of leather that it is difficult to distinguish it from the natural article. For all uses to which it has been applied, the article has proved nearly, if not quite, equal in serviceableness to natural leather.

Cobalt in the Arts.

The application of ores of cobalt for the blue coloration of glass and porcelain appears to have been known and practiced by the ancient Greeks and Romans, since the presence of this metal has occasionally been detected in ancient glass and ceramic wares. The general use of cobalt ores for the manufacture of smalt did not occur until about the middle of the sixteenth century, about which time the art was practiced in Saxony.

The metal cobalt was first isolated and described as a new element by the Swedish chemist Brandt, in 1733. It is closely allied to nickel in many of its properties, and its ores generally occur associated with those of the latter metal. Its chief ores are smaltine, an arsenide of cobalt; iron nickel, some specimens of which often contain as much as 26 per cent of cobalt; cobaltine, or cobalt-glance, a sulph-arsenide of cobalt and iron; and cobalt-bloom, hydrated arsenate of cobalt. The ores of nickel invariably contain a greater or less percentage of cobalt. The preparation of pure metallic cobalt is one of the most delicate and tedious of chemical processes; and as our purpose here is simply to call attention to the practical applications of the metal (and especially of its compounds) in the arts, its metallurgy does not concern us.

The metal has a reddish-gray color, and is susceptible of taking a superb polish. It is less infusible than iron, but more so than gold. Like iron and nickel, it is magnetic, but does not lose its magnetism by heat. Its specific gravity is about 8.5. Its conducting qualities for sound, heat and electricity are about the same as those of iron. It is somewhat malleable at a red heat, when free from manganese or arsenic. It is quite unaffected by air and water at ordinary temperatures, but when intensely heated it burns with a reddish flame. It is only slowly dissolved by hydrochloric acid, but nitric acid or aqua-regia dissolves it readily. The solutions of cobalt salts have

a fine rosy tint, easily recognizable when once seen. Cobalt has been found to make a handsome plating upon copper, brass and iron, rivalling or even surpassing nickel in beauty. Its cost, however, precludes the possibility—at least at the present time—of competing with nickel for this purpose.

Compounds of cobalt possess the property of imparting a beautiful blue color to glassy substances at a red heat. The important blue color known as smalt is made by fusing cobaltous oxide with silicious sand and potassium carbonate in crucibles, and pulverizing the resulting blue glass. This substance was formerly extensively employed for the blue coloration of paper, linen, etc., but its use is now mainly limited to enameling and glazing. A very impure cobaltous oxide is made by roasting smaltine, or cobaltine, mixed with silicious sand, and comes into the market under the name of "zaffre." It is also employed for the blue colorative of glass and porcelain. Therard's blue is prepared by mixing alum with a cobaltous salt, and precipitating the mixture with sodium carbonate, or by decomposing the aluminate of soda by means of cobaltous chloride. The precipitate is an intimate mixture of hydrate of alumina and hydrated oxide of cobalt. After being well washed, dried and heated, the resulting blue pigment bears a close resemblance in color to ultramarine. It is indifferent to acids, alkalies or heat, and is used for staining glass and porcelain, and for oil and water colors.

Coeruleum, another blue color, is a mixture of cobaltous stannate with stannic acid and gypsum. It is likewise unaffected by heat, or by acids and alkalies.

Riemann's green is a compound of cobalt and zinc, made by precipitating with sodium carbonate, a mixed solution of white vitriol (zinc sulphate), and a cobaltous salt. Cobalt yellow is a mixture of nitrate of cobalt and potassium, made by passing nitrous vapors through a solution of cobaltous nitrate to which potassic hydrate has been added.

A remarkable series of compounds of cobalt with ammonia has been observed and studied by Genth, Gibbs, Fremy and others.

The employment of cobalt salts in the laboratory for the detection of manganese, alumina, zinc, etc., by means of the blow-pipe, is very important to the analyst. The sensitiveness of cobalt salts to heat and moisture has been utilized in the production of sympathetic inks, which are invisible at ordinary temperatures, but are rendered visible and legible on heating. For this purpose, the cobaltous chloride, mixed with a small quantity of gum or sugar water, is well adapted. The "magic ink," as it is called, is rendered visible by holding it for a few minutes in the neighborhood of some heated body. It has lately been recommended as very suitable for postal-card messages, which would thus be exempt from curious inspection.

The sensitiveness of cobalt salts to moisture, which is indicated by a change from blue to a pinkish tinge, and *vice versa*, has been suggested and actually employed in the construction of a hygrometer, or measurer of moisture. In France, a recent scientific toy is a flower barometer, which is simply an artificial flower of white paper which has been impregnated with a solution of cobaltous chloride. These flowers, when exposed to the sun and dry air, become deep blue; but when the air is saturated with moisture, they turn to a pinkish hue, thus affording an approximate estimate of the condition of the atmosphere.

Strips of paper saturated with this salt and made into various decorative and fanciful forms, are likewise in common use for a similar purpose. Landscapes have similarly been painted with cobalt and nickel salts, which, on heating, develop the characteristic shades of sky and grass.

The above facts comprise in briefly condensed form the chief technical applications of this interesting metal.

Brickwork Under Pressure.

During the construction of the tunnel under Dorchester Bay, in Boston, it became necessary to construct a brick bulkhead that had to withstand the pressure due a water column 162 feet high, and, as it was intended to shut off a leak amounting to 240,000 gallons per 24 hours, it had to be water-tight. Mr. D. Stauffer gave the following description of this work before the Engineers' Club of Philadelphia:

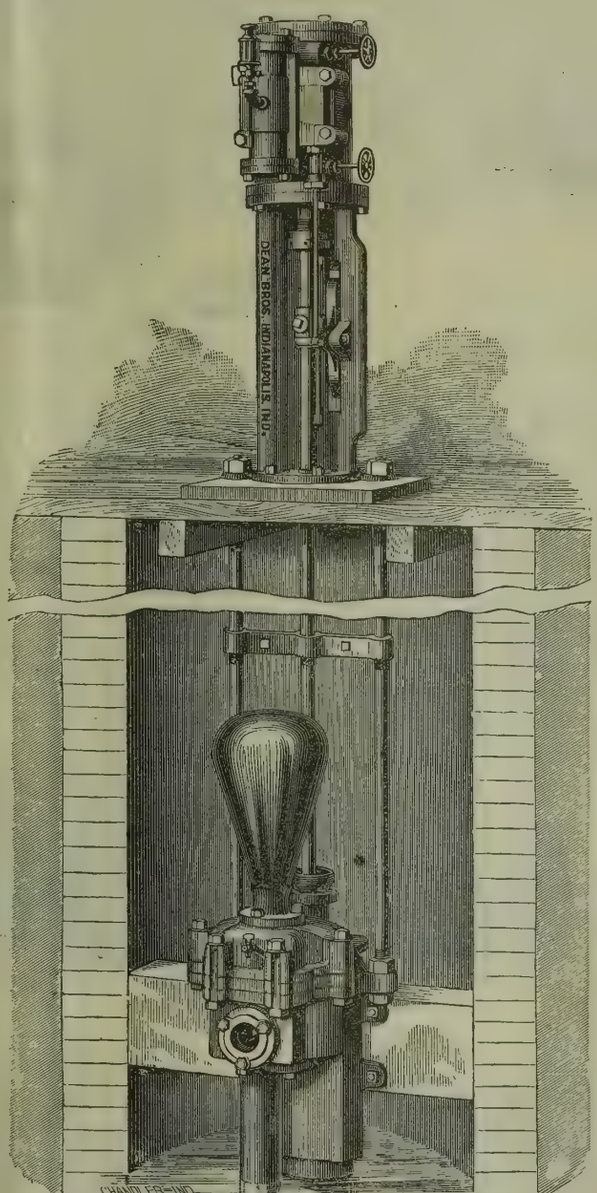


Fig. 3.—Dean Bros. Vertical Pump, for Deep Wells, Mines, etc.

The tunnel section at the point selected for the bulkhead was practically 10 feet square. The bulkhead was built directly across the tunnel, 50 feet in front of the heading where the water was struck. Plank dams filled with puddle clay were first thrown across the tunnel each side of the bulkhead site, and a 6-inch wrought-iron pipe used to carry off the water during construction—the pipe being built into the brickwork. An arched form was adopted, 4 feet thick at the crown and 2 feet rise in a span of 10 feet. Hard-burned bricks were used, laid in mortar made of one part of English Portland, one part Newark Rosendale, and two parts clean, sharp sand— a compound found equally strong with English Portland and sand, one to one, and having the advantage of working smoother on the trowel, and adhering better to brickwork in wet places. Skewbacks for the arch were roughly picked out in the rock at the sides. After the cement had set, the water was shut off by screwing a cap on to the outer end of the 6-inch cap. The pressure against the wall was $72^{1}/_{10}$ pounds per square inch, or about 519 tons distributed over the face of the bulkhead. The wall was tight for about forty-eight hours; then water came through the brick itself, rather than through the joints, in amount equal to one-half the original volume. The water was let off, and a second experiment tried. The main wall was torn down sufficiently to allow men to pass behind it, and a second wall only 12 inches thick was built back of the first, and two feet distant. The space between these walls was well rammed with puddle clay, extending to the rock on all sides. The second wall was made purposely light, as its yielding to the pressure would only more effectually consolidate the clay between it and the unyielding wall in front. The bond used in the main wall was one so laid that there was no continuous horizontal joints through the wall. The result of the last construction was to completely shut off the water from this leak, at a great saving of fuel and pumps.

The Dorchester Bay tunnel is 7,000 feet long, with its average invert grade 143 feet below low-tide mark in the bay under which it passes. The tunnel is driven through a formation of clay, slates and conglomerates for its entire length; rocky, very seamy, and much water encountered.

We may add, that in mining bulkheads, which often must carry much greater pressures, the practice is to let the water rise slowly behind the bulkhead, by allowing a portion of the water to flow through a safety-valve at the bottom of the level. It has been the experience in all such cases that in the beginning quite a quantity of water will come through the pores of the brickwork, which is said to be "sweating." Gradually, however, the pores are filled by carbonate of lime, and a thick coat of that substance forms on the face of the bulkhead, completely cutting off the entire flow of water. A column of from 400 to 500 feet has been borne for many years by such bulkheads.

Protecting Iron.

A new process for preserving iron is described by *Les Mondes*. It consists in treating the casting with dilute hydrochloric acid, which dissolves a little of the metal and leaves a skin of homogeneous graphite holding well to the iron. The article is then washed in a receiver with hot or cold water, or cooked in steam, so as to remove completely the chloride of iron that has been formed. Finally, the piece is allowed to dry in the empty receiver, and a solution of caoutchouc, gutta-percha, or gum resin in essence of petroleum is injected, and the solvent afterward evaporating leaves a hard and solid enamel on the surface of the iron-work. Another plan is to keep the chloride of iron on the metal instead of washing it off, and to plunge the piece into a bath of silicate and borate of soda. Thus is formed a silicoborate of iron, very hard and brilliant, which fills the pores of the metal skin. As for the chlorine disengaged, it combines with the soda to form chloride of sodium, which remains in the pickle.

Boiling Point of Zinc.—M. Tiolle has determined the boiling point of zinc to be 933°, or very near the temperature (932°) given by Becquerel.

The Jersey City Explosion.

BY F. B. ALLEN.

At about 7.45 A.M., September 13th, 1881, a stationary boiler of the locomotive type, upon the floating dock of Messrs. Bulman & Brown, foot of Essex street, Jersey City, N. J., exploded with terrific violence, killing two men and injuring five others, also destroying property to the amount of some $2,000, besides damaging surrounding property to perhaps an equal amount.

The boiler that exploded was but little over three years old. The iron used in its construction was of good quality, if the mill stamp could be relied upon, and there appeared no reason to doubt it. It was stamped in a number of places "Best Flange," and C. H. No. 1 shell, 50,000 pounds, Glasgow Iron Works, Pa.

Its principal dimensions were as follows: Length, 16 feet 4 inches; diameter, 40 inches; fire box part, 54 inches long and 60 inches high. The shell was made up of three courses of ⅝-inch iron plates, single riveted, ¾-inch rivets, head $^{7}/_{16}$ inch. Crown sheets and side sheets of fire-box in one piece, as commonly used in the smaller sizes of this class of boilers. It was $^{5}/_{16}$ inch thick, braced to the wagon top on areas of 39 square inches, side sheets stayed to the shell by screw stay-bolts ⅞ inch diameter, pitched 5¾× 6½ inches between centers, screwed into both sheets and headed up. The front tube head was braced to the shell by three braces; the back head by eight braces, three of which extended well back and attached to the intermediate course of the shell. In speaking of the front and back heads of locomotive boilers there is a possibility of confusion. In this description the front head is the one nearest the front or fire-box end of the boiler, while the back head is at the opposite or smoke-box end. Dome, 24× 30 inches, $^{5}/_{16}$-inch iron, double riveted on flange, wrought-iron dome head securely braced, and substantial man-hole frame on the intermediate course of the shell. There were thirty-eight 3-inch tubes, 10 feet long, rolled into both heads by a Dudgeon expander, and slightly flared on their ends. Beading over iron tubes is practically abandoned in this part of the country. It is not recommended by our boiler-makers, and only done where required by specification. The fittings, in addition to the valves, pipes and usual attachments, were a 2½-inch safety valve, a steam gauge, three gauge cocks, and a glass water gauge. The safety valve was *supposed* to have been set to blow off at about 75 pounds.

The construction of the boiler was workmanlike. Its builder bore a high reputation as a designer and practical boiler-maker of both land and marine work, and many evidences of his skill may be found ashore or afloat. The owners, aware of this fact, probably gave little thought concerning the management of it, no doubt priding themselves on having a first-class boiler, in the use of which there would be no risk or damage for many years. The history of this case will be a profitable study to thousands of steam users in the land who entertain a similar delusion. Let us hope their dream may not have so rude an awakening as the gentlemen of whom I write, who are now under bonds awaiting the action of the Grand Jury for their participation in the negligence of their engineer, besides being threatened by suits at law for the collection of claims arising from loss of life, injuries to limb, and damage inflicted on the property of others. The testimony before the coroner's inquest established the fact that the boiler was a good one, and equipped with the necessary safety appliances relied upon to guard against explosion, in the hands of a competent, attentive engineer. As to the qualifications of the engineer, and his attention to duty, our readers can judge from his testimony, in part as follows: He had been licensed as an engineer in Brooklyn, N. Y.; had charge of the exploded boiler since March, 1880. In addition to his duties as an engineer, he was a fireman, attended to certain lines, and arranged the blocks for the reception and discharge of vessels; sometimes did calking or keel work. The boiler was never inspected or tested to his knowledge. He never was inside the boiler. Had no occasion to go there. The steam gauge was in perfect order; a steam gauge will run six years without testing or repairs. The highest steam pressure he ever saw on the boiler was 78 pounds. Blew off steam from the safety valve on Saturday before the explosion (three days). It was then all right. Started fire in the furnace the morning of the explosion, so as to have steam at 7 o'clock to lower a boat that had been docked for repairs. Had permission to go home from one of the firm, having received a telegram announcing the sickness of a member of his family, and requesting his presence. Recommended the employment of another engineer to look after the boiler in his absence.

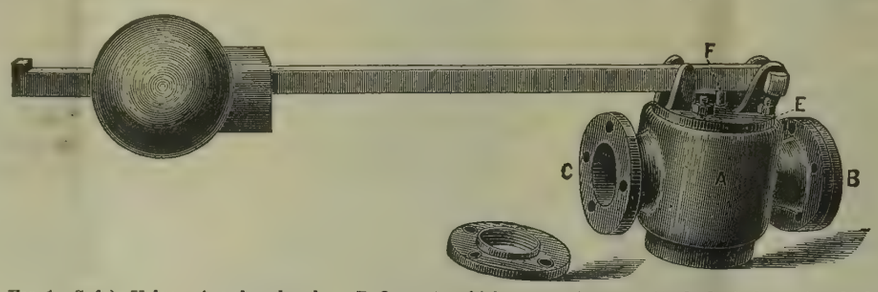


FIG. 1.—Safety Valve. A, valve chamber; B, flange to which escape pipe was attached; C, flange to which steam pipe was attached; E, bonnet; F, wrought-iron valve stem.

Some time before 7 o'clock, a young man who sometimes assisted as a fireman about the boiler and engine, came on duty. Learning of the engineer's absence, and fearing they would be behind time in getting up steam, he added fresh fuel to the fire and closed the furnace door, that had been left ajar by the engineer. At this time he was ordered away to assist in moving a barge. He admits being absent about 45 minutes. He seems to have forgotten all about the boiler, when, hearing an unusual noise from escaping steam, he climbed up to the boiler, found the fire room full of steam, which he says seemed to blow out around the seams about the front. While attempting to reach and open the furnace door with a long pole, the boiler exploded and he was dangerously injured.

The force of the explosion projected the cylinder part of the boiler, weighing approximately two tons, some 650 feet, while the fire box part was blown in the opposite direction, and part of it fell into the river. The attending circumstances indicated an explosion by an over-pressure of steam. This theory was fully confirmed by an examination of the safety valve, Figs. 1 and 2, the stem of which F was corroded fast in the bonnet E, so much so that a pressure of 3,200 pounds was required to lift it one-32d of an inch, the pressure being gradually increased with a slight upward movement of the valve until 4,000 pounds was applied, when it raised ¼ inch from its original position—4,000 pounds being equivalent to 816 pounds per square inch upon the boiler. From that point the valve was driven out of the chamber by a hammer. Its stem was found perfectly straight, but when the scales of rust were removed, it was found to have been reduced one-16th of an inch in diameter in that part of the stem where corrosion occurred. It was the opinion of the expert who made the examination and test, that corrosion had been going on for a long time, part of which time it had not progressed sufficiently to affect the working of the valve. He certainly did not, nor did any one else having any knowledge of the subject, credit the engineer's story that the valve had been in good working order less than three days before the explosion.

The safety valve, Figs. 1 and 2, had the appearance of an old design. The valve stem F, being made of wrought iron, instead of composition, there was a constant danger of its corroding fast in the cast-iron bonnet E, through which it passed to connect with the valve lever. The aperture in the bonnet was probably too close a fit in the first instance. This dangerous defect, as might naturally have been expected, escaped the attention of every one about the boiler, but was detected by an expert engineer, who examined the valve immediately after the explosion. Though the use of the iron valve stem was attended with danger, and might have been expected to end in disaster in the hands of the average boiler attendant, it would not have occurred under the care of a competent engineer, who attended to the raising of a safety valve daily, not by hurridly raising the valve lever, but by assuring himself that the valve lifted from its seat and steam escaped.

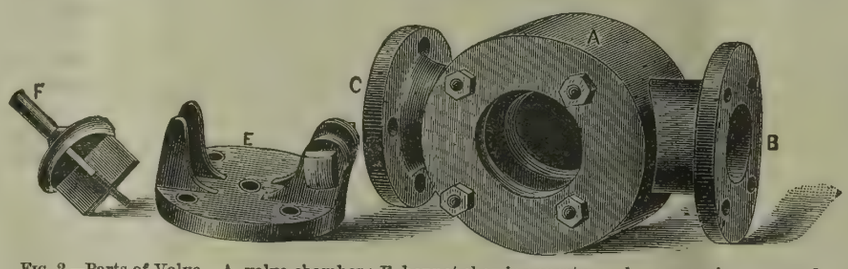


FIG. 2.—Parts of Valve. A, valve chamber; E, bonnet showing aperture where corrosion occurred; F, valve and stem—iron stem rigidly attached. Like letters refer to the same parts in both cuts.

Many steam users have what appears to me a very foolish objection to steam from the safety valve escaping into the fire room, and in ridding themselves of what they may regard as an annoyance they expose themselves to dangers they little dream of, making a pipe connection to the exit side of the safety valve to carry off the escaping steam. With this connection, at times it is very difficult to tell whether the safety valve is blowing off freely or not, particularly if more than one boiler is blowing off at the same time, without going out doors where the open end of the pipe may be seen. There are at least two other objections that may be urged against such an arrangement of escape pipe: 1. Tendency of the weight of the attached piping to produce distortion of the valve chamber. 2. And the increased danger from corrosion due to the condensation of the steam, and descent of the water to its lowest point, where it remains until evaporated, or displaced by the next blowing out. The safety valve, Fig. 1, had a pipe so connected, which retarded the free escape of steam. It will be recollected the valve was 2½ inches in diameter, having an area of $2.5^2 \times .7854 = 4.90$ square inches, which was rather small for the work. The effect of the 1¼-inch escape pipe was to reduce its effective area to $1.5^2 \times .7854 = 1.76$ square inches, making it dangerously small, the increased friction of the pipe and elbow not being considered.

From the preceding detailed statement as to the material and construction of the boiler, its use, and the manner in which it was cared for, all practical determinations, it will, I am sure, be apparent to the reader there exists not the slightest necessity for invoking a mysterious agency to account for this explosion.

Improvements in Wood-Working and other Machinery.

Of the accompanying engravings, Fig. 1 represents an improved wood-splitting machine, invented by Robert G. Brock, of Cedar Rapids, Iowa. The inventor has sought to devise a machine that will split

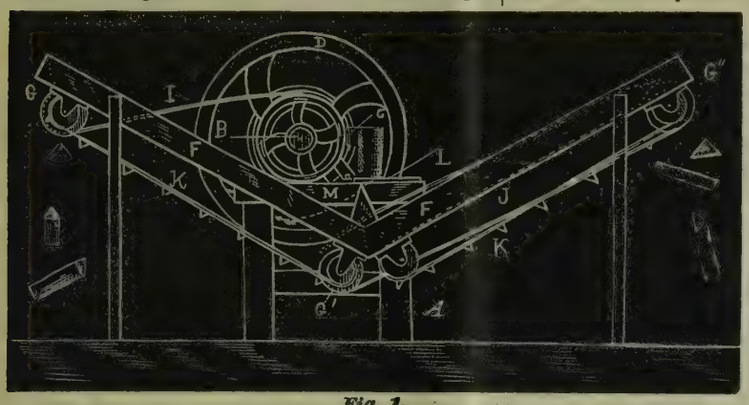


Fig. 1.

wood rapidly and satisfactorily, and remove the same, after splitting as fine as needful, to any suitable distance from the machine and deposit it in a pile or piles, with but little labor to the operator. This last object the inventor claims to be an entirely novel one in the construction and operation of machines of this class. The mechanical details of the device will be readily understood from the following description, reference being had to Fig. 1: A is a strong frame, upon which is mounted a revolving shaft B, carrying a heavy cleaver C. Motion is imparted by means of a pulley on the driving shaft, and the speed is kept uniform by the heavy balance wheel D. The stick of wood to be split is placed upright on the roughened bed plate L and held loosely between the hands of the workman while the cleaver splits it as fine as may be required. At the side of the machine, within easy reach of the operator, is attached a carrier F F′, similar in general construction to the carrier of a threshing machine. This may be a single or double carrier, as shown in the drawing, in which case it piles twice as much wood, and may be used to separate the hard from the soft wood as fast as split. The apron K K is operated by means of the belt or chain I passing from the pulley H on the main shaft to the pulley G at the upper end of the carrier F. The endless apron K communicates motion to the pulley G G′, and thence to the other apron.

Fig. 2 represents an improvement in head-blocks for saw mills, invented by Darius Parkhurst, of St. Louis, Mo. The inventor provides the following means for accomplishing his object. The gauge or

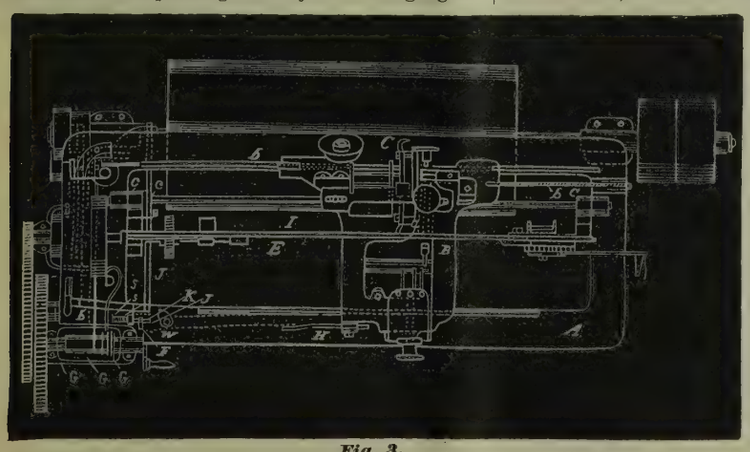


Fig. 3.

stop is set, and the movement of the adjustable lever determines the movement of the log and the thickness of the board. A friction brake attachment permits a backward movement of the knees under excessive shocks or pressure.

Fig. 3 represents an improvement in lathes for turning irregular forms, devised and patented by Edward Myers, of Cincinnati, O. In this device the work-carrying frame may be swung back from the cutter by cams on a rock shaft working against the frame. The clutch mechanism operating the winding shaft (by which the cutter frame is drawn from end to end of the work) is uncoupled by a pin on the frame moving back a spring bolt. The same pin actuates the mechanism which swings back the work-frame. The

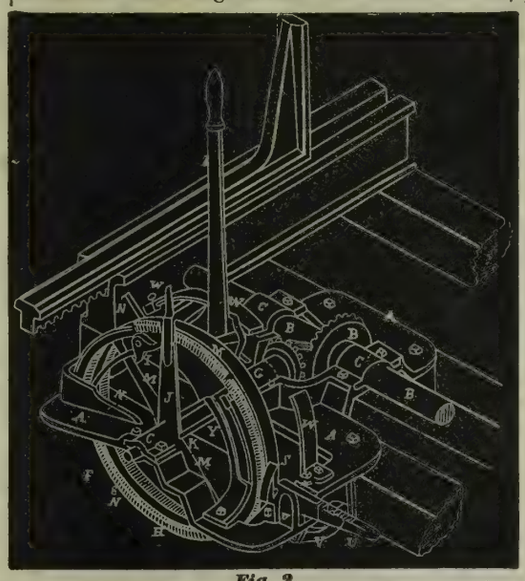


Fig. 2.

principal claim of the inventor is the following, The combination, with the vertical work-carrying frame E, arranged independently of the driving mechanism of the lathe; of a rock shaft arranged at one side of said frame and provided with cams *c c* and lever mechanism, substantially as described, connected with the rock shaft and under control of the operator, whereby the rock shaft can be rotated and the cam caused to move and retain the work-carrying frame away from the cutters at any stage of the cutting operation.

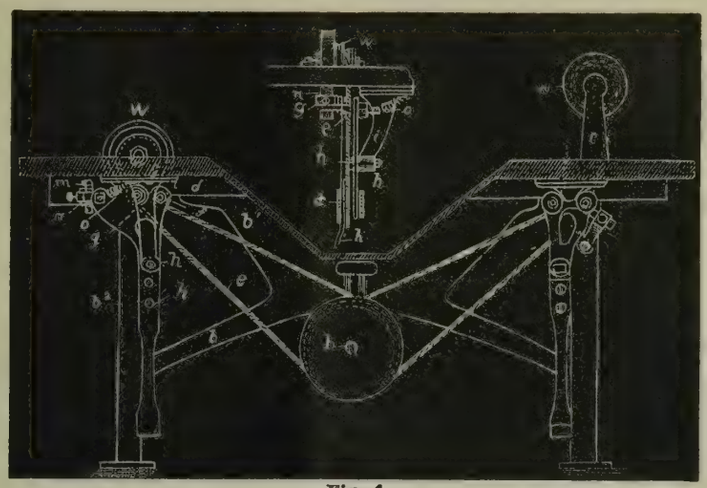


Fig. 4.

Fig. 4 illustrates an improvement in mechanism for controlling belts, invented by George H. Phelps, of Newton, Mass. The invention has for its object to provide a simple mechanism by which the driving belt of a sewing, or other light, machine may be quickly tightened through a lever operated by the foot, or otherwise, thus driving the machine; or when the belt is left slack, to cease to drive it. At the same time, the inventor prefers to provide the belt-tightening lever with a brake which will be applied directly to the driving belt or to the fly wheel of the machine to be driven, as soon as the belt is permitted to become slack, to stop the movement of the machine. Accordingly, after the inventor's description, the driving belt extends from the fly wheel of the machine to a belt pulley on a power-driven shaft of a shop or mill, is acted upon by two sheaves carried by a lever, shown in cuts, pivoted to a hanger below the work-bench upon which the machine stands, these sheaves causing the driving belt to be strained sufficiently to exert more or less friction upon the pulley of the driven shaft and the fly wheel, to insure the application to the fly wheel of sufficient power to drive it, according to the work being done. The operator, by more or less pressure on the lever carrying the sheaves, may regulate the amount of slippage of the belt on the fly wheel, and consequently the speed of the machine may be kept equal to the speed of the power shaft which moves the belt, or be made to run slower than the said power shaft. The belt-tightening lever is furthermore provided with a brake, which, as the

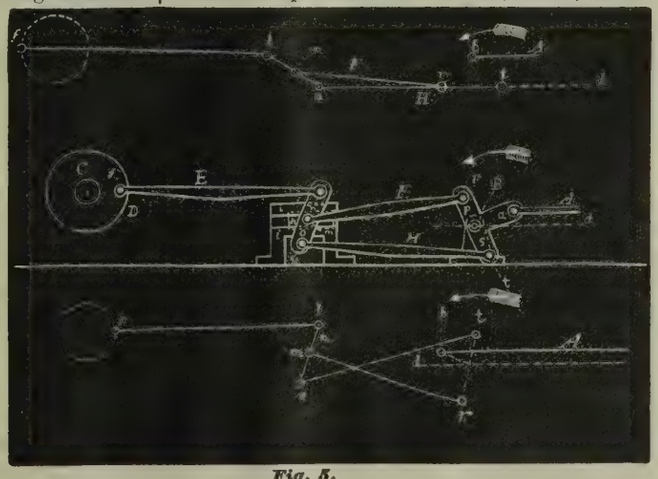


Fig. 5.

driving belt is slackened sufficiently to stop the machine, comes against the driving belt and stops it quickly; or the brake under like circumstances may operate directly against the fly wheel of the sewing-

machine. At the left of the engraving (Fig. 4) is represented a shop-bench or work-table, having at opposite sides of it this belt-tightening apparatus; in the center is a view of the belt-tightener. The bench or table *a* is supported on metallic cross pieces *b*, inclining downward at *b'* and forming braces b^3, attached to the uprights b^2. The views show the invention connected with the driving mechanism of several forms of sewing machines in common use. To avoid showing a sewing machine a standard *c* is represented supporting the fly wheel *w* at the right. The shaft *d*, supported in suitable adjustable bearings connected with the cross pieces *b b'*, is driven continuously by power, and is called the "power shaft." This power shaft, run continuously, is employed to run any or all of the sewing machines which are mounted upon the work-bench at each side. The power shaft has a pulley d^2 for each sewing machine, and machines at opposite sides of the work bench are driven from pulleys by belts *e*, which are passed from pulleys d^2 about the belt-receiving parts of pulleys or fly wheel W of usual construction, connected with the sewing or other machines to be driven. These belts may be open or crossed, as desired. Portions of each belt between pulleys d^2 and pulleys or fly wheels W are made to bear against sheaves *f g*, carried by a lever *h*, pivoted at h^2 on a hanger *i*, the lever having preferably a foot-pad or projection h^3. Movement of the lower end of the lever *h* by the foot toward the shaft *d* will cause the sheaves *f g* to strain the belt *e*, and the machine may, as the belt *e* is tightened, be driven more or less rapidly until the speed of the pulley or fly wheel W is equal to the speed of the pulley d^2. Releasing the pressure on the lever slacks the belt *e*, so that its friction on pulley d^2 and fly wheel W is insufficient to drive the fly wheel. As the pressure of the sheaves *f g* on the belt *e* is taken off, outward movement of the lower end of lever *h* causes the pad *m* of arm *n* to be pressed directly against the fly wheel W or against the belt, the brake in both cases acting to immediately check the fly wheel or the belt, preventing either of them, as the case may be, from running longer than desired. A suitable spring *o* keeps the brake up to its work, and normally keeps the lever *h* in the position shown in the engraving, with the brake against the fly wheel or band *e*.

Fig. 5 illustrates an ingenius mechanical movement, invented by Arthur E. Rust, of Pine Meadow, Conn. The invention is a modification of the usual simple method of converting reciprocating into rotary motion, and has for its object to produce *two* full rotary movements to each full reciprocating movement. The inventor explains that his device is applicable to steam engines where a rapid revolution of the fly wheel is desirable without a corresponding rapidity of movement of the piston; and also to other devices where a reciprocating motion is to be converted into a rotary one, and the rotary motion is desired to be rapid. It consists in the interposition between the pitman or connecting rod which receives the reciprocating motion and the crank to which it is transferred, of a system of levers arranged and made to operate in the manner about to be described.

Of the illustrations, the middle figure is a side view, and the upper and lower figures are diagrams illustrating the operations. A, may represent the pitman or connecting rod, and is supposed to be connected with an ordinary steam engine piston. Instead of being attached to the usual crank, it is attached to an arm *a*, or it may be a wheel on a rock shaft B. The reciprocating movement imparted to the pitman is less than the full diameter of the circle which would be described by the point *b* where the pitman is attached—that is to say, it starts forward above the dead line *d*, as seen in the middle figure, and terminates at the opposite side at a corresponding point *e*, also above the dead line *d*, as seen in the lower figure, so that the pitman imparts a vibratory motion to the arm or wheel to which it is attached—that is to say, from the piston in the middle figure to that in the lower figure, and return; C is the driving shaft, to which the crank wheel D is attached; E, the connecting rod, which is hung to the crank D on a crank pin *f* in the usual manner. Midway between the rock shaft B and the driving shaft is a slide *h*, arranged in horizontal guides *i* in the usual manner for arranging a cross-head. To this slide a lever is hung, as at *m*, so as to swing in a plane parallel with that in which the cranks turn; it extends above the pivot to form an arm *n*, to which the connecting rod E is attached, as at *l*, and below to form a like arm *o*. From the rock shaft B an arm *p* extends up at right angles to the arm *a*; to this arm *p*, at a point *r*, one end of a connecting rod F is hung; the other end is hung to the lever *n o*, and at its center of vibration. Opposite the arm *p* is an arm *s*, and to that arm, at a point *t*, distant from the center of motion the same as the point *r*, one end of a second connecting rod H is hung, its other end hung to the arm *o*, as at *u*. These joints are made in the usual manner.

The foregoing somewhat lengthy description of the mechanism is necessary in order to comprehend its operation, which is as follows: Starting from the position in the middle figure, which is the most forward position of the piston, and the piston moving to the rear to its first quarter or half throw, the arms *p s* will be turned to bring their respective points *r t* diametrically opposite each other in a horizontal line. This will throw the slide or point *m* to its extreme rear position, and the connecting rod H will draw the lower end of the arm or point *u* to its extreme forward position, and which, through the connecting rod E will throw the crank or point *f* to its extreme rear position, or opposite point to which it started, and will have made one-half revolution of the driving shaft, while the piston has moved but one-half its extent. The piston, continuing its movement, carries the point *b* to its opposite or extreme forward position, as seen in the bottom figure. This quarter movement, turning the arm *a* to the position *b*, brings the point *t* up and the opposite point *r* down, and draws the slide or point *m* to its extreme rear position, throwing the point *u* forward and the point *l* rearward, which brings the crank or point *f* back to its point of starting, while the piston has only traveled from one end of its cylinder to the other, or one-half of the reciprocating movement only has been performed, The piston returning, and when at the third quarter of its movement, or one-half its return, the points are brought again to the position as seen in the top figure, and one-half the revolution of the point *f* has been made. Continuing to its other extreme and completing the reciprocating movement, the parts are brought again to the position as seen in the middle figure, and completes the second revolution of the driving shaft or point *f*. Hence it will be seen that by one complete reciprocation two full revolutions have been produced.

The piston or power which imparts the reciprocating motion does not at any time come to a dead point at either end of its stroke, because the extent of the oscillation or vibration of the point *b* is less than one-half a full circle.

Applied to a steam engine, this mechanism imparts to the driving shaft two revolutions for each full reciprocation of the piston—a great advantage where rapid revolution of the driving shaft is desirable. This illustration as applied to a steam engine, will be sufficient to enable a skilled mechanic to apply it to other machinery where it is required to convert reciprocating into rotary motion.

A NEW SOUNDING APPARATUS.—A Russian naval officer has invented a very ingenious apparatus for ascertaining the depth of the sea without the use of a costly and heavy line. Indeed, no line at all is used. The instrument consists of a piece of lead, a small wheel with a contrivance for registering the number of revolutions, and a float. While the apparatus sinks the wheel revolves, and the registered revolutions indicate the depth. When the bottom is reached, the lead becomes detached, the float begins to act, and the machine shoots up to the surface, where it can easily be fished up by a net and the register read off.

Further Comments on Lawson's Experiments.

Since penning the editorial reflections, in our May number, upon the interesting bearings of Mr. Lawson's experiments, we have had the opportunity of reading in the *Locomotive*, the monthly bulletin of the Hartford Steam Boiler Inspection and Insurance Company, a review of the Munhall Farm experiments recorded in full in our last issue, and find that the general conclusions reached by Mr. A. C. Getchell, the chief inspector for the Cleveland (O.) department, who represented the Hartford company as a witness at the trial tests, substantially agree with those we have expressed.

Mr. Getchell briefly states the purpose of the Munhall Farm proceedings as follows: "The object of the experiments was to demonstrate the truth of the theory held by Mr. Lawson that boiler explosions are caused by the opening of a valve, whereby the steam escapes, and the highly heated water remaining in the boiler, thus relieved from pressure, suddenly flashes into steam, producing a concussion great enough to explode the boiler."

After detailing the circumstances and results of the trials of the boiler, with and without the perforated diaphragm, which correspond substantially with the account we published, Mr. Getchell, referring to the final explosion of the boiler at 235 pounds pressure when the diaphragm had been removed, makes the following general summary: "Pieces of the shell were tested after the explosion by Capt. Fehrenbatch, on a Riehlé testing machine, and found to have a tensile strength of 61,449 pounds per square inch, which is remarkably strong for iron boiler plate. From the results of the experiments, it is probable that many destructive boiler explosions may be averted by the use of Mr. Lawson's apparatus; still it is evident that it cannot influence the effects of varying expansion, crystallization, corrosion, and other kindred defects, and that boilers must still be very carefully watched and often inspected."

In an editorial reference to the subject which we find in the same issue of the bulletin, the editor, while admitting the value of Mr. Lawson's intelligent and careful treatment of this subject, expresses doubts as to the general utility of his perforated diaphragm as a preventive of explosion. This is the safe, conservative view to take of it, until Mr. Lawson shall, by further practical tests, enable the engineering fraternity to form a decided opinion of its merits.

Electric Lighting and Steam Heating.

Two great improvements in the business and domestic economy of New York city are being pushed with vigor. These are the Edison electric light system and the steam-heating system. By the former it is proposed to introduce electric lights into private and business houses to take the place of gas—such a prolific source of fires; and by the second it is intended to substitute steam for the great variety of heating appliances now in use, thus doing away with a fruitful source of danger. The electric light company has nearly completed its arrangements for lighting one district in the lower part of the city, and it is expected that the system will be in full operation in that section by the first of July. The steam-heating company is engaged in putting down their pipes, encased in wood to prevent condensation of steam, and the numerous streets that are rendered almost impassable by their operations, testify to the energy with which they are pushing their work. By fall they expect to have their pipes laid in all the lower part of the city, and to be ready to supply steam as required for heating or for motive power before "snow flies."

The Production of Gold and Silver for 375 Years.

Dr. Adolph Soetbeer publishes a report upon the precious metals, taking the year 1493 as the starting date in his computations, claiming that the modern history of gold and silver begins with the return of Columbus from his first voyage to the New World. Towards the end of the fifteenth century, before the treasures of America were unlocked, the supply of the precious metals in civilized countries had fallen far below the requirements of trade. Mr. Jacobs' conjecture in regard to the specie which was available for the exchanges of Europe in 1492, rates the total sum at no more than $165,000,000. Since then the mines of of the world have furnished over fourteen and a half billions in silver and gold. We present below a valuation of the weights tabulated by Dr. Soetbeer, for three hundred and eighty-two years, from 1493 to 1875, supplemented by an estimate of the production for the three years 1875 to 1878, uncovered by his table:

	Production of precious metals from 1493 to 1878.
Gold	$6,612,193,087
Silver	7,976,429,920
Total	$14,588,623,007

We desire at present to direct attention to the steady increase in the supply of the precious metals from century to century, and especially to the enormaus figures of the gold production during the last twenty-eight years. That the position may be seen at a glance, we have prepared tables of the annual average supply for each of the precious metals by decades or double decades from 1493 to the end of last year. The production of each century is summarized and averaged by itself. Our readers will do well to preserve the tables for reference. Average annual production:

SIXTEENTH CENTURY.

Years.	Gold.	Silver.
1493 to 1520	$3,856,578	$2,015,125
1521 to 1544	4,758,536	3,867,325
1545 to 1560	5,655,746	12,359,850
1561 to 1580	4,545,864	12,841,062
1581 to 1600	4,904,748	17,960,337

The total production in the one hundred and eight years, from 1493 to 1600, amounted to $501,693,248, in gold, an average of $4,645,307 per annum; and $976,024,900 in silver, an average of $9,065,045.

SEVENTEENTH CENTURY.

Years.	Gold.	Silver.
1601 to 1620	$5,662,392	$18,134,837
1621 to 1640	5,516,180	16,875,600
1641 to 1660	4,828,542	15,705,112
1661 to 1680	6,154,196	14,448,875
1681 to 1700	7,154,419	14,658,962

The total production in the one hundred years, from 1601 to 1700, amounted to $606,314,580 in gold, an average of $6,063,145 per annum; and $1,596,407,750 in silver, an average of $15,964,077.

EIGHTEENTH CENTURY.

Years.	Gold.	Silver.
1701 to 1720	$8,520,172	$15,246,350
1721 to 1740	12,680,568	18,487,700
1741 to 1760	16,355,806	22,858,591
1761 to 1780	13,760,543	27,986,227
1781 to 1800	11,823,234	27,689,697

In the hundred years, 1701 to 1800, the production aggregated $1,262,806,400 in gold, an average of $12,628,064; and $2,445,371,337 in silver, an average of $24,154,713.

NINETEENTH CENTURY.

Years.	Gold.	Silver.
1801 to 1810	$11,815,258	$38,336,681
1811 to 1820	7,606,347	23,185,513
1821 to 1830	9,447,953	19,746,510
1831 to 1840	13,484,069	25,572,793
1841 to 1850	36,392,831	33,460,293
1851 to 1860	134,107,307	38,396,813
1861 to 1870	125,284,742	52,312,537
1871 to 1878	112,081,628	82,400,000

In the seventy-eight years, 1801 to 1878, the production aggregated $4,278,938,135 in gold, an average of $54,846,642 per annum; and $2,969,306,913 in silver, an average of $38,068,037 per annum.

Hyde's Improved Centering Machine.

The accompanying cuts represent views of a new and improved centering machine, introduced by the Geo. Place Machinery Company, No. 121 Chambers street, this city. The machine in question has some valuable features that distinguish it from other machines of the same general character. Of the cuts, Fig. 1 gives a general view of the machine, and Fig. 2 represents the details of the centering chuck, showing very clearly the principle on which it operates.

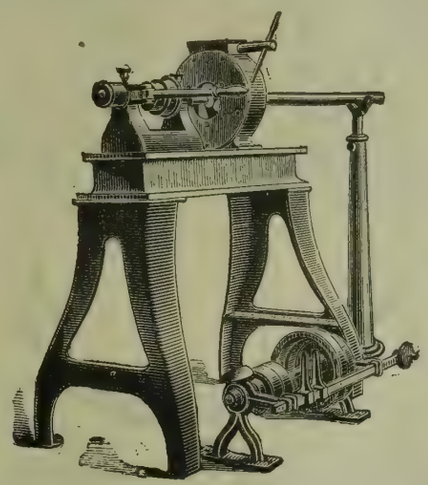


Fig. 1.—General View, showing the Adjustable Forked Rest.

The jaws are of hardened steel, made unusually large and strong, being 2¾ inches wide and 1 inch thick; they are pivoted, as seen in the engraving (Fig. 2), and so arranged that they are all operated simultaneously by turning the handle which communicates with the fixed screw at the top, which, by means of the movable nut, gives motion to a ring inside of the case that communicates with each of the jaws by means of studs suitably fitted. The jaws open sufficiently to admit shafts up to 4½ inches in diameter, and fit accurately on diameters as small as ⅛ inch. The spindle which carries the centering drill is of steel, and is moved forward and backward by means of a hand lever, and, being feathered, revolves with the cone. This lever, instead of working directly with the rack, communicates motion to it by means of a pinion interposed between the two parts. By this means the spindle is operated by a pulling instead of a pushing motion, which is a desirable improvement over many of the tools in existence. The floor stand has a wide base, and is substantial in construction. The rest for sustaining the end of the shafting being centered, is adjustable as to hight.

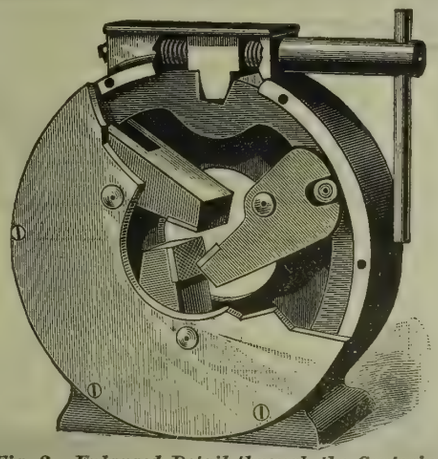


Fig. 2.—Enlarged Detail through the Centering Chuck.

The materials employed and the construction are of the best, and the manufacturers do not hesitate to fully guarantee the tool.

The Manufacture of Gun-Cotton.

In giving the details of a series of trials made at Stowmarket, England, with some new explosives, *Engineering* prints the following description of the process of manufacturing gun-cotton, as developed by Prof. Abel, of Woolwich:

The raw material employed is the finest cotton waste, costing about $180 per ton, or double the price of the ordinary cotton waste employed so largely in factories for cleaning machinery. After having been carefully hand-picked, the waste is fed into vertical iron cylinders, where it is dried by forcing in air having a temperature of 160° Fah., by means of a blower, the air being heated with the waste steam from one of the engines. When the drying process has been accomplished, the cotton is passed through a carding machine, is rolled up into cylinders, and packed away until wanted. The conversion is effected by immersing one-pound charges of the dried cotton in a mixture of the strongest nitric and sulphuric acids, in the proportion of three parts by weight of the latter to one of the former. The cotton only remains for a minute or two in the acid, and is then taken out, and as much as possible of the acid is squeezed out of it by means of a lever hand-press. It is then put into wide-mouthed earthen jars, covered with fresh acid, and the jars are allowed to stand in large, shallow troughs of cold water, to prevent undue heating, for twenty-four hours. The conversion into gun-cotton is now complete. The remaining processes of the manufacture have for their object the thorough cleansing of the cotton from the last traces of acid, and the packing of the cotton into the most convenient shapes for the purposes for which it is intended to be employed. The cleansing process is of the greatest importance, and is also most laborious. The gun-cotton, when taken from the jars, is thrown into centrifugal strainers, in which the greater part of the acid is expelled by centrifugal action. This is a most expensive process, as the cylindrical strainers are very costly, and are worn out by the straining of a couple of tons of cotton. After this, the cotton is diffused through a large volume of water, and again passed through the centrifugal strainers. It is next boiled by steam in large wooden tubs, then tested for acid, and if necessary re-boiled. The next process is the pulping, which facilitates the cleansing from the last traces of acid, and also reduces the cotton to a condition in which it can be easily formed into cartridges. The pulping machine is an oval wooden tub, in which is set a horizontal revolving wheel of a diameter equal to half the smaller diameter of the oval. Strips of steel project from its circumference and under surface, and the cotton, which is swimming in water, is drawn in by the wheel and passed out between its circumference and under surface and the sides of the tub, and is thus reduced by the steel strips to the state of pulp. The bottom of the tub is adjustable, so that the space between it and the bottom of the wheel can be continually contracted as the pulping progresses. When the pulping is completed, the cotton is again finally washed by being mechanically stirred in water in large wooden tubs, and the pulp is then separated from the water by means of presses formed of large cylinders with perforated plungers worked by hydraulic power. The mass is then further pressed into its final shape, dependent on its ultimate use, in a second hydraulic press, a pressure of six tons per square inch being applied.

STEEL MAKING IN COLORADO.—The Bessemer steel works of the Colorado Coal and Iron Company, at South Pueblo, went into operation on the 11th of April, and the first Bessemer rails made in the Rocky Mountain region were rolled on the 12th. The newspapers of the State are jubilant.

The Signal Service and its Methods.

[*Continued from page 85, April Number.*]

Rules for Regulating Clock of Self-Register.—If the clock varies less than 10 or 15 minutes a day; if too slow, the regulator R is turned to the "left." If too fast, it is turned to the "right," Fig. 7. When it varies 20 or 30 minutes a day. If too slow, the pin P is taken out and the end of the spring set farther into the hole; if too fast, the spring is taken farther out of the hole where held by P. When it varies over 30 minutes a day, the regulator R is set in the center; and if too slow, the three screws S S S of the balance wheel are tightened equally; if too fast, they are loosened equally. In both cases about one turn is allowed for every 30 minutes' variation. If the escapement pin E vibrates more on one side the forks of the lever L than on the other, the hair spring must be brought either to the right or to the left on the axis, which can be done by inserting a small screw-driver into the slot W to hold it in position while turning the balance wheel in the desired direction.

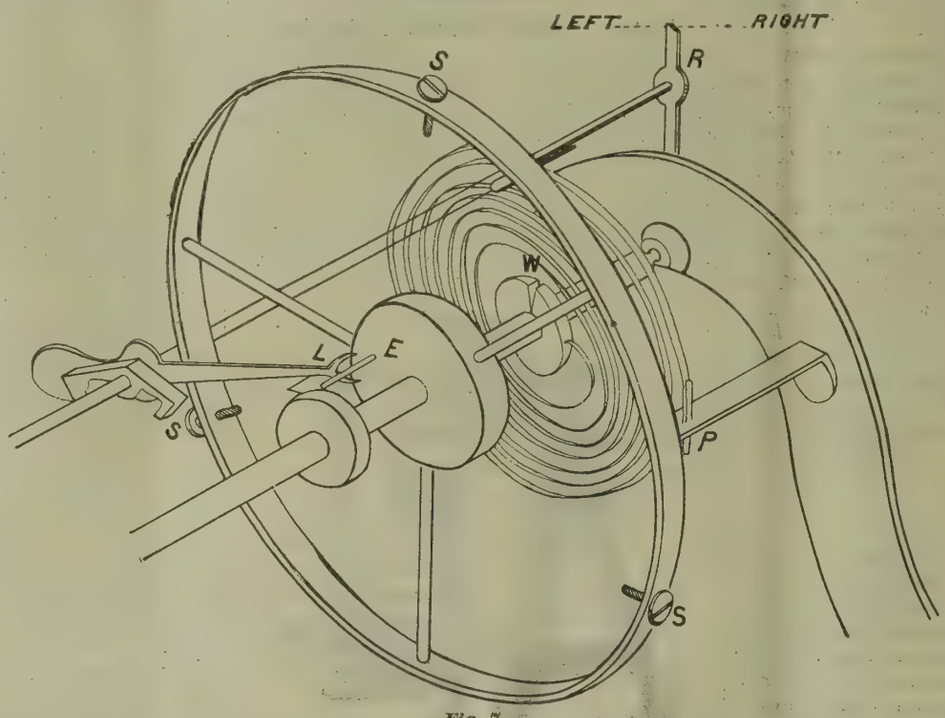


Fig. 7.

Setting up the Anemograph with the Eccard Contact.—Fig. 8 shows the position of the contact when the vane rod passes through the roof to the ceiling of the office. Fig. 9 shows the position of the contact and the friction rollers when inclosed in a cast-iron base on the roof of a building; and Fig. 10 shows the courses of the different circuits from the anemometer and anemoscope through the registering attachment to the battery. To place the contact in position, as shown in Fig. 8, the vane rod must be placed so as to extend from 3½ to 4 four inches below the ceiling, and the following directions be carefully observed: 1. The circuit closer C C C C, Fig. 8, must be fastened to the vane rod with the set-screws close to the ceiling, and the end of the rod then passed through the aperture in the lower side of the brass support B B, which must be securely fastened to the ceiling. 2. The brass plate A A, with which the four contact springs N E S W are connected, must be screwed to the support B B in such a manner that the contact springs will be parallel with and opposite to their respective cams on the circuit closer *c c c c*. 3. The circuit closer is adjusted by having an assistant hold the wind vane in a due north direction, loosening the set-screws of the circuit closer, and turning it around until the point of the spring N corresponds with the notch filed in the uppermost cam on the circuit closer opposite to the spring N. When this has been done, the circuit closer is firmly fastened to the vane rod by means of the set screws. 4. Before connecting the five-wire cable, it is tested and the wires marked N, E, S, W and R respectively at both ends. The covering is removed from the cable for at least 6 inches at the end to be connected with the contact, the ends of the wires cleaned, connected with the five binding posts at the ends of the springs N, E, S, W, Fig. 8, then the cable fastened to the ceiling and conducted to the instrument by the most practicable route, where the four wires N, E, S, W, are connected with the binding screws N, E, S, W, shown in Fig. 10. The fifth wire R must be connected with one pole of the battery C, C', Z, as is shown in Fig. 10. 5. The other pole Z of the battery is connected with the binding screw R. 6. When it is desired to work the anemometer circuit with only a part of the battery, the wire from the binding screw *a* on the anemometer is led to any one of the battery cells. (The number of cells to be used will depend upon the length of the anemometer circuit). The current of all the cells in the battery will, however, be brought into action when the direction circuit is closed, at regular intervals, by means of the clock contact. The other wire *d* is led from the anemometer to the binding post V on the recording instrument. (See Fig. 10). 7. When all the wires have been properly placed, the arrow or indicator must be screwed to the vane rod immediately under the lower portion of the brass support B, B, Fig. 8.

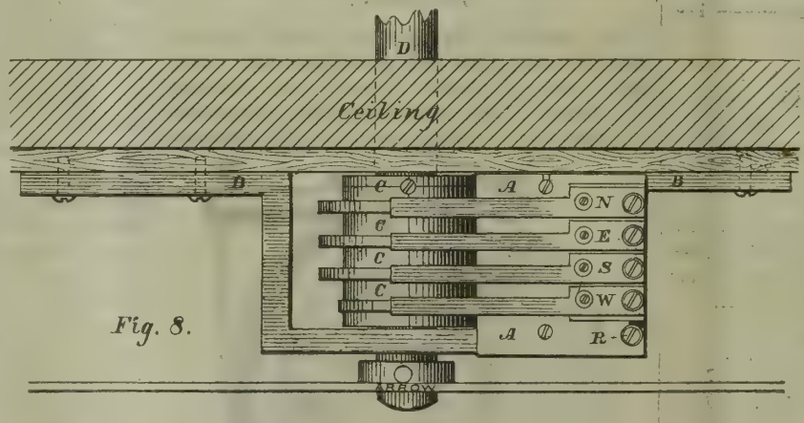


Fig. 8.

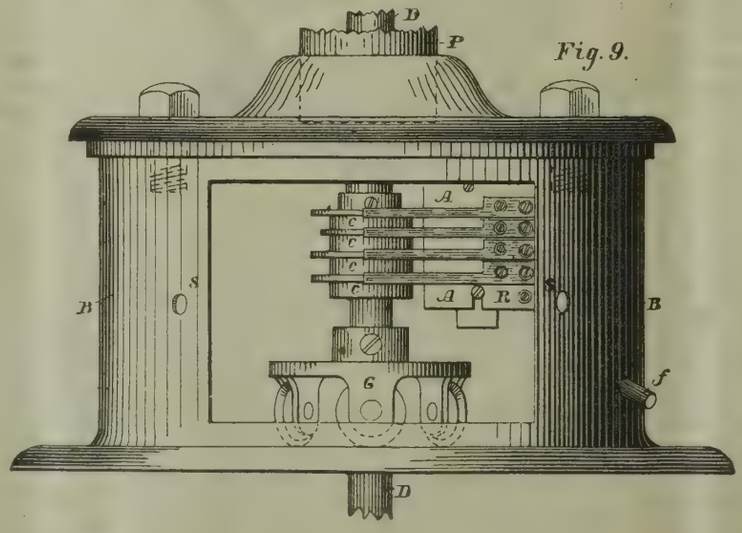


Fig. 9.

Where an office is so located that the vane rod cannot be passed through the roof to the ceiling, a cast-iron base B B, Fig. 9, is furnished. A suitable wooden block is firmly fastened to the roof, upon which the cast-iron base is securely attached. The lower end of the pipe P, through which the vane rod passes, is placed in the socket in the top of the cast-iron base, and the valve rod D D itself passed through the two apertures in the top and bottom of the base B B, and through the wooden block underneath the base. A hole should be bored in the wooden block of greater diameter than the vane rod, in order to prevent friction. In erecting the vane, care must be taken to place it at such an elevation that the vane rod will not extend too far below the iron base. After the large pipe P supporting the vane is firmly braced to the roof, and before the vane is attached to the rod, the contact friction rollers G must be placed in position. This is done by raising the vane rod sufficiently to enable the circuit closer *c c c c* and friction rollers G to be slipped on the lower end of the rod; the rod is lowered to its former position so that the upper friction rollers (which are immediately below the vane) will rest upon the cap of the pipe; then the lower friction rollers G are fastened to the vane rod D D, so that the weight of the rod will be as equally distributed as possible between the upper and lower friction rollers. The circuit closer *c c c c* and plate A A are placed in position, (see Fig. 9), the cable K (Fig. 10) passed through the small pipe *f* (Figs. 9 and 10), and the wires connected in the manner before described.

Batteries.—Two forms of batteries are used in the Signal Service, both of them being modifications of the well-known Daniell's battery. The following instructions for setting up and managing them are given:

The Field Battery.—1. In putting the battery together for use, the porous cup is placed inside the copper vessel, and the star-shaped zinc element inside the porus cup. 2. The copper vessel is filled with a strong solution of sulphate of copper (prepared in another vessel by dissolving about half a pound of crystals of the sulphate in a quart of pure water) to within one inch of the top. Crystals of the sulphate must never be plunged in the copper vessel, neither must sulphuric acid be used to strengthen the battery, as by so doing the copper vessel will be rapidly destroyed. The porous cup is then filled with pure water to within one inch of its top. 3. After all the cells are filled in this manner, the copper (positive) pole of one cup is connected with the zinc (negative) pole of the next one by short pieces of insulated copper wire, using the copper clamps for attaching the ends of the wires to the zincs, and the fixed binding screws for attaching them to the coppers. The main wires, through which the circuit is formed, are attached to the copper and zinc elements of the outside or end cups, respectively. 4. A battery carefully put up in this manner should work with but slight diminution of force for at least fourteen days, at the end of which time the porous cups must be taken out, emptied, washed thoroughly, all the pure copper on their outer sides removed, and then refilled with pure water. Care must be taken to avoid disturbing the paraffine at the bottom of the cups, as it is placed there to prevent contact between the zinc and copper elements. The zincs must be thoroughly cleaned with the battery brush provided for that purpose. 5. The liquid in the copper vessels must not be changed as often as the water in the porous cups, but only when it loses its dark-blue color. It must be stirred daily, in order to keep it of equal strength above and below, as the sulphate held in solution has a tendency to settle to the bottom, on account of its greater specific gravity, thereby localizing its action. 6. The binding screws and the ends of the small connecting wires must be kept scrupulously clean to insure good connections, and the copper vessels kept at least one inch apart to prevent contact. The cells should rest on a painted wooden base, to insulate them from each other and from the earth, and care be taken to prevent any escape of liquid from the several cells by which a connection might be formed between them. 7. The copper vessels must be kept properly painted on the outside.

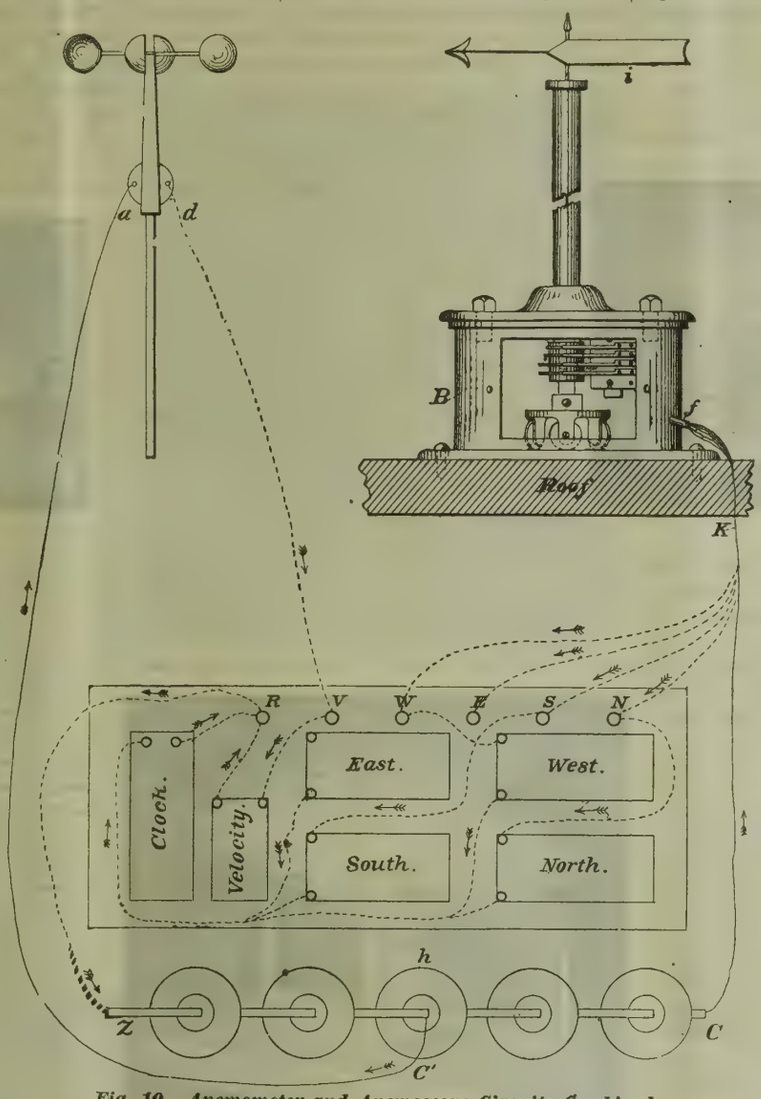


Fig. 10.—Anemometer and Anemoscope Circuits Combined.

Wind Vane.—Two wind vanes are furnished to each station; a small one, to be sent with the original station supplies for immediate use, and a larger one, or standard, to be sent as soon after the station is opened as practicable. The vane used for determining the direction of the wind must be set where the wind may act freely upon it, and must never be sheltered by surrounding buildings or other objects. Where the vane rod does not pass through the roof to the office, the observer is required to mark upon a wooden dial, at the base of the upright which supports the vane, the true meridian and the cardinal points of the compass. At stations where the rod connected with the standard wind vane passes through the roof and indicates the direction of the wind by an arrow in the office room, the arrow must be adjusted to correspond exactly in direction with the vane itself, and when such adjustment has been made, the arrow must be securely fastened by means of the set-screw, forwarded from the central office for that purpose. A competent mechanic is employed to perform such part of this work as cannot be done by the observer. When the large vane is received at any station, it is immediately erected upon the building in which the office is located, provided the consent of the owner can be obtained, and the roof is strong enough to support its weight. When the office is on the upper floor, the central rod is brought into the room and allowed to project about four inches below the ceiling. The gilded arrow is then screwed on, and two circles drawn around it on the ceiling a little greater in diameter than the length of the arrow. Between these circles are painted the eight points of the compass used in the weather reports, care being taken to get the true meridian as a starting point. Observers are required to daily examine the vane and the arrow under the ceiling to see that they point in the same direction. To fix the north and south line of the vane circle in the "true meridian," a table is placed directly under the end of the vane rod, from the center of the end of the rod a plummet is suspended, and the compass is placed upon the table with its center directly under the end of the plummet. If the variation of the magnetic needle is given as *east* a certain number of degrees, the compass is turned until the north end of the needle reads that many degrees *east* of the N point on the face of the compass. If the variation is *west*, the compass is turned until the needle reads the given number of degrees *west* of the N point. A straight-edge is then laid across the face of the compass so that it will pass through the N and S points of the face, which are in the "true meridian," two points are marked upon the table under the straight-edge, a straight line drawn through the points, the plummet string held against the vane circle and moved along until the plummet point crosses the straight line on the table upon both the north and south sides, and these crossings marked upon the circle, which are the "true" N and S points.

These instructions are based upon the supposition that the compass used is marked so that when placed upon a table and the observer sights from S to N the E point is on his right hand and the W to his left. Should the E point, as marked on the compass, be to the left and the W point to the right, when the variation is given as *east*, the compass is turned until the north end of the needle reads the given number of degrees toward the west point; if *west*, it is turned until the needle reads the proper number of degrees toward the east point.

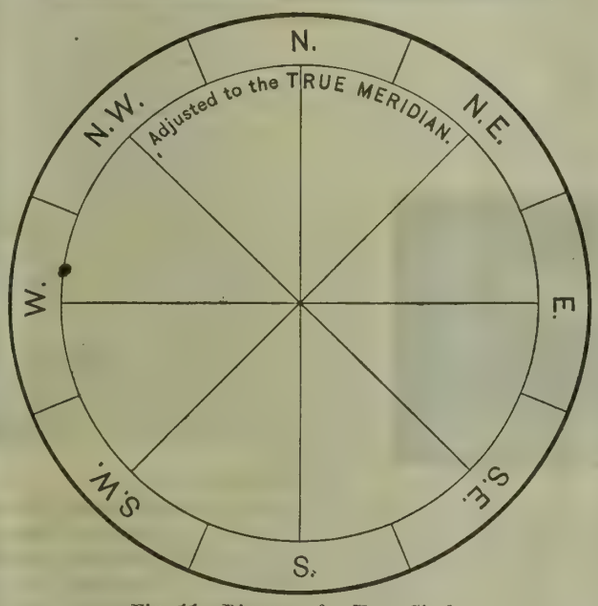


Fig. 11.—Diagram for Vane Circle.

At all stations supplied with the standard wind vane, with the indicator extending through the roof to the office ceiling, the words "adjusted to the true meridian," are painted inside the vane circle, upon the ceiling. (See Fig. 11).

The observation of the vane requires more care than is usually given. In winds of considerable strength the vane is never at rest or fixed in the same direction; it oscillates incessantly, and its oscillations increase in extent with certain winds and with the violence of the wind. In such cases observers are directed to note the mean direction between the extremes. When the wind is too light to move the vane, and when it is too calm, no direction is recorded. The direction of the wind is designated by the eight principal points of the compass, namely, N., NE., E., SE., S., SW., W. and NW. In reporting changes in the direction of the wind, the terms "veering" and "backing" are used. In the northern hemisphere the term "veering" indicates the changing of the wind from

N. to E. to S., and so on, or in the direction corresponding with the movements of the hands of a watch; while "backing," being the reverse term, indicates that it changes from N. to W. to S., and so on. The bearings of the vane must be kept well and carefully oiled to prevent friction.

Radiant Matter.

[In view of the classic nature of the investigations and experiments of Dr. Wm. Crookes, F.R.S., upon this subject, which were lately given to the world in a lecture delivered before the British Association, and as the best means of answering inquiries that we have received respecting the subject, we herewith reproduce the lecture of Dr. Crookes in full, with the exception of certain references, which are omitted as unnecessary.—*Ed. M. & B.*]

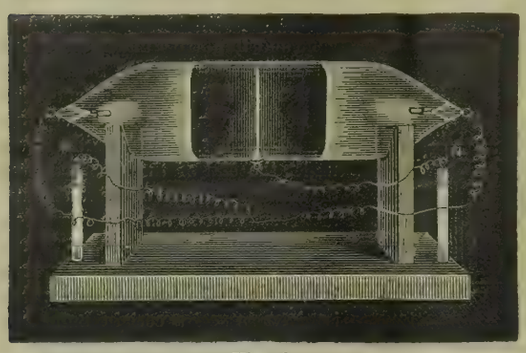


Fig. 1.

To throw light on the title of this lecture, I must go back more than sixty years—to 1816. Faraday, then a mere student and ardent experimentalist, was 24 years old, and at this early period of his career he delivered a series of lectures on the general properties of matter, and one of them bore the remarkable title, "On Radiant Matter." The great philosopher's notes of this lecture are to be found in Dr. Bence Jones's "Life and Letters of Faraday," and I will here quote a passage in which he first uses the expression "radiant matter": "If we conceive a change as far beyond vaporization as that is above fluidity, and then take into account also the proportional increased extent of alteration as the change rises, we shall perhaps, if we can form any conception at all, not fall far short of radiant matter; and as in the last conversion many qualities were lost, so here also many more would disappear."

Faraday was evidently engrossed with this far-reaching speculation, for three years later (in 1819) we find him bringing fresh evidence and argument to strengthen his startling hypothesis. His notes are now more extended, and they show that in the intervening three years he had thought much and deeply on this higher form of matter. He first points out that matter may be classed into four states—solid, liquid, gaseous and radiant—these modifications depending upon differences in their several essential properties. He admits that the existence of radiant matter is as yet unproved, and then proceeds, in a series of ingenious analogical arguments, to show the probability of its existence.

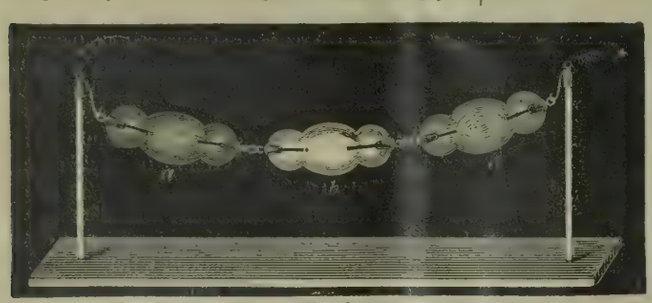


Fig. 2.

If in the beginning of this century we had asked, What is a gas? the answer then would have been that it is matter, expanded and rarefied to such an extent as to be impalpable, save when set in violent motion; invisible, incapable of assuming or of being reduced into any definite form like solids, or of forming drops like liquids; always ready to expand where no resistance is offered, and to contract on being subjected to pressure. Sixty years ago such were the chief attributes assigned to gases. Modern research, however, has greatly enlarged and modified our views on the constitution of these elastic fluids. Gases are now considered to be composed of an almost infinite number of small particles or molecules, which are constantly moving in every direction with velocities of all conceivable magnitudes. As these molecules are exceedingly numerous, it follows that no molecule can move far in any direction without coming in contact with some other molecule. But if we exhaust the air or gas contained in a closed vessel, the number of molecules become diminished, and the distance through which any one of them can move without coming in contact with another is increased, the length of the mean free path being inversely proportional to the number of molecules present. The further this process is carried the longer becomes the average distance a molecule can travel before entering into collision; or, in other words, the longer its mean free path, the more the physical properties of the gas or air are modified. Thus, at a certain point the phenomena of the radiometer become possible, and on pushing the rarefaction still further—that is, decreasing the number of molecules in a given space and lengthening their mean free path, the experimental results are obtainable to which I am now about to call your attention. So distinct are these phenomena from anything which occurs in air or gas at the ordinary tension, that we are led to assume that we are here brought face to face with matter in a fourth state or condition—a condition as far removed from the state of gas as a gas is from a liquid.

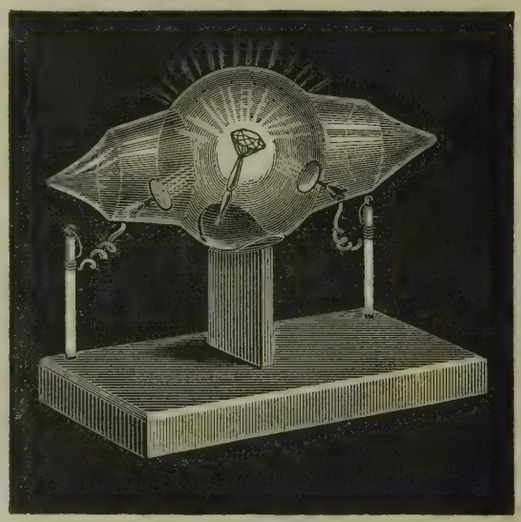


Fig. 3.

Mean Free Path—Radiant Matter.—I have long believed that a well-known appearance observed in vacuum tubes is closely related to the phenomena of the mean free path of the molecules. When the negative pole is examined while the discharge from an induction coil is passing through an exhausted tube, a dark space is seen to surround it. This dark space is found to increase and diminish as the vacuum is varied, in the same way that the mean free path of the molecules lengthens and contracts. As the one is perceived by the mind's eye to get greater, so the other is seen by the bodily eye to increase in size; and if the vacuum is insufficient to permit much play of the molecules before they enter into collision, the passage of electricity shows that the dark space has shrunk to small dimensions. We naturally infer that the dark space is the mean free path of the molecules of the residual gas, an inference confirmed by experiment.

I will endeavor to render this dark space visible to all present. Here is a tube (Fig. 1), having a pole in the center in the form of a metal disk, and other poles at each end. The center pole is made negative, and the two end poles connected together are made the positive terminal. The dark space will be in the center. When the exhaustion is not very great the dark space extends only a little on each side of the negative pole in the center. When the exhaustion is good, as in the tube before you, and I turn on the coil, the dark space is seen to extend for about an inch on each side of the pole. Here, then, we see the induction spark actually illuminating the lines of molecular pressure caused by the excitement of the negative pole. The thickness of this dark space is the measure of the mean free path between successive collisions of the molecules of the residual gas. The extra velocity with which the negatively electrified molecules rebound from the excited pole keeps back the more slowly moving molecules which are advancing toward that pole. A conflict occurs at the boundary of the dark space, where the luminous margin bears witness to the energy of the discharge. Therefore the residual gas—or, as I prefer to call it, the gaseous residue—within the dark space is an entirely different state to that of the residual gas in vessels at a lower degree of exhaustion. To quote the words of our last year's President, in his address at Dublin: "In the exhausted column we have a vehicle for electricity not constant like an ordinary conductor, but itself modified by the passage of the discharge, and perhaps subject to laws differing materially from those which it obeys at atmospheric pressure."

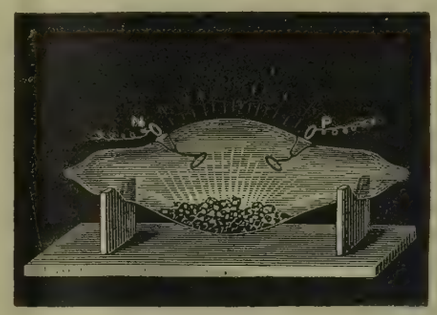


Fig. 4.

In the vessels with the lower degree of exhaustion, the length of the mean free path of the molecules is exceedingly small as compared with the dimensions of the bulb, and the properties belonging to the ordinary gaseous state of matter, depending upon constant collisions, can be observed. But in the phenomena now about to be examined, so high is the exhaustion carried that the dark space around the negative pole has widened out till it entirely fills the tube. By great rarefaction the mean free path has become so long that the hits in a given time in comparison to the misses may be disregarded, and the average molecule is now allowed to obey its own motions or laws without interference. The mean free path, in fact, is comparable to the dimensions of the vessel, and we

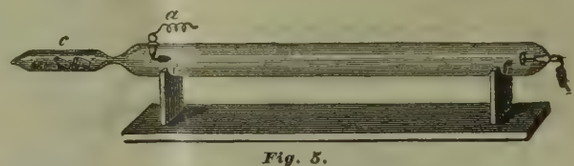


Fig. 5.

have no longer to deal with a *continuous* portion of matter, as would be the case were the tubes less highly exhausted, but we must here contemplate the molecules *individually*. In these highly exhausted vessels the molecules of the gaseous residue are able to dart across the tube with comparatively few collisions, and, radiating from the pole with enormous velocity, they assume properties so novel and so characteristic as to entirely justify the application of the term borrowed from Faraday—that of "radiant matter."

Radiant Matter Exerts Powerful Phosphorogenic Action where it Strikes.—I have mentioned that the radiant matter within the dark space excites luminosity where its velocity is arrested by residual gas outside the dark space. But if no residual gas is left, the molecules will have their velocity arrested by the sides of the glass, and here we come to the first and one of the most noteworthy properties of radiant matter discharged from the negative pole—its power of exciting phosphorescence when it strikes against solid matter. The number of bodies which respond luminously to this molecular bombardment is very great, and the resulting colors are of every variety. Glass, for instance, is highly phosphorescent when exposed to a stream of radiant matter. Here (Fig. 2) are three bulbs composed of different glass, one is uranium glass (*a*), which phosphoresces of a dark green color; another is English glass (*b*), which phosphoresces of a blue color; and the third (*c*) is soft German glass—of which most of the apparatus is made—which phosphoresces of a bright apple green.

My earlier experiments were almost entirely carried on by the aid of the phosphorescence that glass takes up when it is under the influence of the radiant discharge; but many other substances possess this phosphorescent power in a still higher degree than glass. For instance, the luminous sulphide of calcium prepared according to M. Ed. Becquerel's description. When the sulphide is exposed to light—even candle-light—it phosphoresces for hours with a bluish-white color. It is, however, much more strongly phosphorescent to the molecular discharge

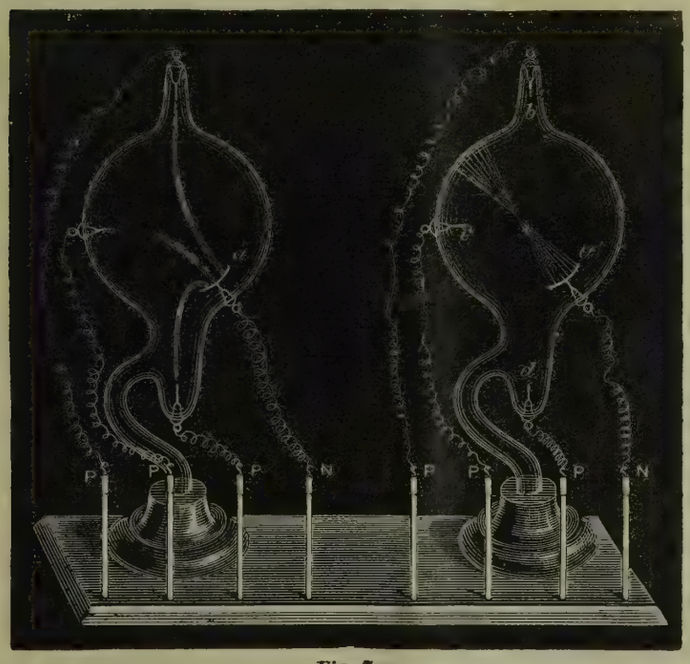


Fig. 7.

in a good vacuum. Other substances besides English, German and uranium glass, and Becquerel's luminous sulphides, are also phosphorescent. The rare mineral phenacite (aluminate of glucinum) phosphoresces blue, the mineral spodumene (a silicate of aluminum and lithium) phosphoresces a rich golden yellow; the emerald gives out a crimson light. But without exception, the diamond is the most sensitive substance I have yet met for ready and brilliant phosphorescence. Here is a very curious fluorescent diamond—green by daylight, colorless by candle-light. It is mounted in the center of an exhausted bulb (Fig. 3), and the molecular discharge is directed on it from below upward. On darkening the room the diamond shines with as much light as a candle, phosphorescing of a bright green.

Next to the diamond the ruby is one of the most

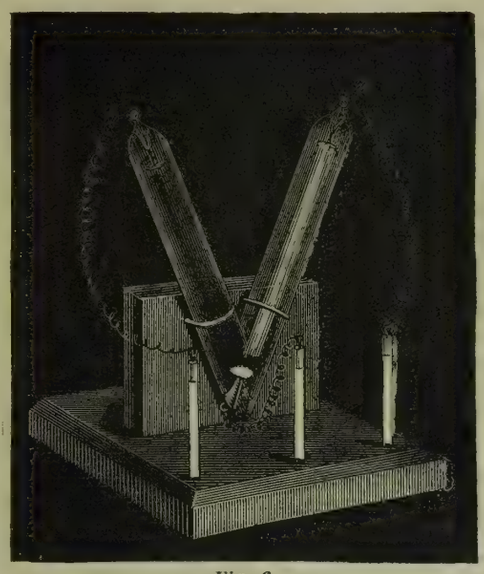


Fig. 6.

remarkable stones for phosphorescing. In this tube (Fig. 4) is a fine collection of ruby pebbles. As soon as the induction spark is turned on these rubies shine with a brilliant rich red tone, as if they were glowing hot. It scarcely matters what color the ruby is, to begin with. In this tube of natural rubies there are stones of all colors—the deep red and also the pale pink ruby. There are some so pale as to be almost colorless, and some of the highly prized tint of pigeon's blood; but under the impact of radiant matter they all phosphoresce with about the same color.

Now, the ruby is nothing but crystallized alumina, with a little coloring matter. In a paper by Ed. Becquerel, published twenty years ago, he describes the appearance of alumina as glowing with a rich red color in the phosphoroscope. Here is some precipitated alumina prepared in the most careful manner; on being heated to whiteness it glows under the molecular discharge with the same rich red color.

The spectrum of the red light emitted by these varieties of alumina is the same as described by Becquerel twenty years ago. There is one intense red line, a little below the fixed line B in the spectrum, having a wavelength of about 6895. There is a continuous spectrum beginning about B, and a few fainter lines beyond it, but they are so faint in comparison with this red line that they may be neglected. This line is easily seen by examining with a small pocket spectroscope, the light reflected from a good ruby.

There is one particular degree of exhaustion more favorable than any other for the development of the properties of radiant matter which are now under examination. Roughly speaking, it may be put at the millionth of an atmosphere. At this degree of exhaustion the phosphorescence is very strong, and after that it begins to diminish until the spark refuses to pass. The tube, Fig. 5, will serve to illustrate the dependence of the phosphorescence of the glass on the degree of exhaustion. The two poles are at *a* and *b*, and at the end (*c*) is a small supplementary tube connected with the other by a narrow aperture, and containing solid caustic potash. The tube has been exhausted to a very high point, and the potash treated so as to drive off moisture and injure the vacuum. Exhaustion has then been recommenced, and the alternate heating and exhaustion repeated until the tube has been brought to the state in which it now appears. When the induction spark is first turned on nothing is visible—the vacuum is so high that the tube is non-conducting. The potash is now slightly warmed and a trace of aqueous vapor liberated. Instantly conduction commences, and the green phosphorescence flashes out along the length of the tube. The heat is continued, so as to drive off more gas from the potash. The green gets fainter, and now a wave of cloudy luminosity sweeps over the tube and stratifications appear, which rapidly get narrower, until the spark passes along the tube in the form of a narrow purple line. The lamp is taken away and the potash allowed to cool; as it cools, the aqueous vapor, which the heat had driven off, is reabsorbed; the purple line broadens out and breaks up into fine stratifications; these get wider, and travel toward the potash tube; now a wave of green light appears on the glass at the other end, sweeping on and driving the last pale stratification into the potash; and now the tube glows over its whole length with the green phosphorescence.

Radiant Matter Proceeds in Straight Lines.—The radiant matter, whose impact on the glass causes an evolution of light, absolutely refuses to turn a corner. Fig. 6 is a V-shaped tube, with a pole at each extremity. The pole at the right side being negative, the whole of the right arm is flooded with green light, but at the bottom it stops sharply and will not turn the corner to get into the left side. When the current is reversed and the left pole made negative, the green changes to the left side, always following the negative pole and leaving the positive side with scarcely any luminosity. In the ordinary phenomena exhibited by vacuum tubes—phenomena with which we are all familiar—it is customary, in order to bring out the striking contrasts of color, to bend the tubes into very elaborate designs. The luminosity caused by the phosphorescence of the residual gas follows all the convolutions into which skillful glass-blowers can manage to twist the glass. The negative pole being at one end and the positive pole at the other, the luminous phenomena seem to depend more on the positive than on the negative at the ordinary exhaustion hitherto used to get the best phenomena of vacuum tubes. But at a very high exhaustion the phenomena noticed in ordinary vacuum tubes when the induction spark passes through them—an appearance of cloudy luminosity and of stratification—disappear entirely. No cloud or fog whatever is seen in the body of the tube, and with such a vacuum as I am working with in these experiments the only light observed is that from the phosphorescent surface of the glass. The two bulbs (Fig. 7) are alike in shape and position of poles, the only difference being that one

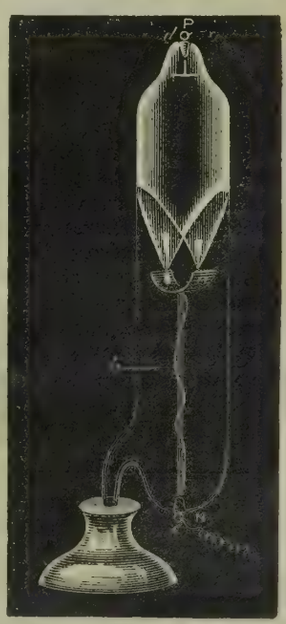


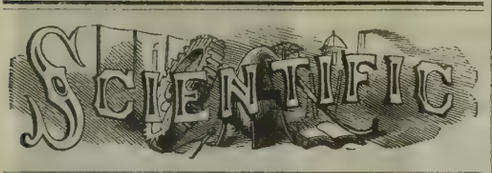
Fig. 8.

is at an exhaustion equal to a few millimeters of mercury—such a moderate exhaustion as will give the ordinary luminous phenomena—while the other is exhausted to about the millionth of an atmosphere. I will first connect the moderately exhausted bulb A with the induction coil, and retaining the pole at one side *a*, always negative, I will put the positive wire successively to the other poles with which the bulb is furnished. As the position of the positive pole is changed, the tinge of violet light joining the two poles changes, the electric current always choosing the shortest path between the two poles, and moving about the bulb as the position of the wires is altered. This, then, is the kind of phenomena we get in ordinary exhaustions. I will now try the same experiment with a bulb (B) that is very highly exhausted, and, as before, will make the side pole *a'* the negative, the top pole *b* being positive. Notice how widely different is the appearance from that shown by the last bulb. The negative pole is in the form of a shallow cup. The molecular rays from the cup cross in the center of the bulb, and thence diverging fall on the opposite side and produce a circular patch of green phosphorescent light. Now I remove the positive wire from the top and connect it with the side pole *c*. The green patch from the divergent negative focus is there still. I now make the lowest pole *d* positive, and the green patch remains where it was at first, unchanged in position or intensity.

We have here another property of radiant matter. In the low vacuum the position of the positive pole is of every importance, while in a high vacuum the position of the positive pole scarcely matters at all; the phenomena seem to depend entirely on the negative pole. If the negative pole points in the direction of the positive, all very well, but if the negative pole is entirely in the opposite direction it is of little consequence; the radiant matter darts all the same in a straight line from the negative.

If, instead of a flat disk, a hemi-cylinder is used for the negative pole, the matter still radiates normal to its surface. The tube shown in Fig. 8 illustrates this property. It contains, as a negative pole, a hemi-cylinder *a* of polished aluminum. This is connected with a fine copper wire *b*, ending at the platinum terminal *c*. At the upper end of the tube is another terminal *d*. The induction coil is connected so that the hemi-cylinder is negative and the upper pole positive; and when exhausted to a sufficient extent the projection of the molecular rays to a focus is very beautifully shown. The rays of matter being driven from the hemi-cylinder in a direction normal to its surface, come to a focus and then diverge, tracing their path in brilliant green phosphorescence on the surface of the glass.

[*To be Continued.*]



The Cause of Tubercular Diseases.—Prof. Tyndall deserves much credit for promptly making known to English readers, in language free from scientific technicalities, the important discovery of Prof. Koch, of Berlin, respecting the nature and causation of tubercular diseases, which, in the form commonly known as pulmonary consumption, is one of the most fatal diseases among civilized people.

Prof. Koch has found as the result of much patient and laborious research, that tubercular deposits in the lungs, etc., are in every case accompanied by the presence of certain minute parasites called *bacilli*. He has succeeded not only in identifying this parasite, but in cultivating it outside of the human body, and in reproducing the disease, with all its characteristic symptoms, in living animals, by inoculating them with the cultivated parasite. The value of this discovery cannot at present be properly estimated; but as the first and most important step in the rational treatment of any malady is to understand its nature and cause, the discovery of Prof. Koch has carried us on with a long stride towards the right mode of checking or averting this dread scourge of the human race. He has shown that consumption is a zymotic or germ disease, and hence contagious. We know from his discovery that the disease is propagated by the introduction of a specific germ from without, and that a person having pulmonary consumption may communicate the malady to another, unless precautions are used to prevent it.

But though these discoveries bring into prominence the terribly dangerous character of these diseases, they furnish at the same time a reasonable hope that means may also be discovered of checking their fatality by so modifying the character of the tubercle-bacillus by artificial cultivation—as Pasteur has shown to be possible with the germs of splenic fever—as to mitigate its virulence and fatality, so that the modified bacillus may be used as a preventive by a process of inoculation, as is the case with small-pox and the splenic fever in cattle.

New Minerals.—Hieratite is the name given by Cassa to a new mineral occurring in microscopic crystals in volcanic tufa around the fumaroles of the crater of the Island of Vulcano. The crystals dissolve in boiling water, from which a gelatinous substance separates, which, after drying, becomes a mass of transparent isometric crystals, having the form of the cube modified by the octahedron. The chemical composition of the crystals was found to be that of a fluo silicate of potassium.

The same observer notes the abundant occurrence, at the same place, of a soluble tin salt, and also of a soluble bismuth salt, both of which he suspects to be new.

Heldburgite is the name given by Leudecke to a mineral occurring in minute yellow columnar crystals found in the phonolite of the Heldburg, in Coburg, associated with zircon. It is infusible, transparent, with white streak, and adamantine luster. Its composition is unknown.

Krugite is the name given a new sulphate of calcium, magnesium and potassium found in the Stassfurt rock-salt deposits. It is crystalline, with hardness 3.5, and specific gravity 2.8.

Mr. F. Heddle has described in the Proc. Mineralogical Society of Great Britain, a number of supposed new minerals found in Scotland. To these suppositious new species he has attached the following names: Pilolite; Mountain Leather, usually regarded as a fibrous variety of amphibole; Rubislite, a mineral resembling closely the doubtful species, hullite; Xantholite, occurring in yellow nodules, and resembling chondrodite; Balvraidite, an altered feldspar; Abriachanite, a bluish mineral, probably a decomposition product, and consisting of silicate of iron and magnesia; Haughtonite, a black mica resembling biotite, but considered by H. C. Lewis to be identical with his siderophyllite from Pike's Peak, Col.; Walkerite, a variety of pectolite, containing magnesia; Bhreckite, a soft, granular, pale-green substance resembling glauconite; Tyrecite, a name applied to a reddish residuum left of dissolving certain marbles in hydrochloric acid; and Torbermorite, a massive, uncleavable zeolite. Most of these new (?) species and varieties are undoubtedly simply mixtures or decomposition products, and Prof. Lewis, who refers to them in his excellent summary of mineralogical news in the *American Naturalist*, very properly expresses his doubts as to the advantage to science of new names given with so much freedom to substances, the identity of which rests on such uncertain evidence.

Prof. C. U. Shepard describes in the *American Journal of Science*, two new minerals from the Twin Islands, Mona and Moneta, in the West Indies, and which he names from the locality of their occurrence, Monite and Monetite. Tney are both phosphates of lime. Monetite is dicalcic hydric phosphate; crystalline, its forms belonging probably to the trichinic system; color, yellowish-white; fracture, uneven; luster, vitreous; semi-transparent; hardness, 3.5; specific gravity=2.75. Produced from the metamorphosis of guano. Monite, occurs with monetite, and has a similar origin. It is hydrated tricalcic phosphate, resembling in color and density the more friable varieties of koalinite. It is massive; slightly coherent; snow-white; fracture, earthy, dull; hardness, below 2; specific gravity=2.1, approximately.

Bailey's Astral Lantern.—An ingenious apparatus for aiding the study of the heavens, and which is worthy of attention on the part of teachers, as an excellent aid in practically familiarizing pupils with the positions and movements of the heavenly bodies, consists of four illuminated maps of the heavens, so arranged and provided with appliances for adjustment that the student may have before him, whichever part of the heavens he is facing, a correct map of that part in the best possible position for comparison therewith.

The maps contain, in correct position, brilliant representations of all the stars seen by the naked eye, different sized disks representing their different magnitudes; also, in tint, their names and Greek-letter symbols, the constellation boundaries, mythological figures and names, and marks to show the location of the most interesting clusters and nebulæ, multiple and variable stars also being distinguished by marks.

In the southern side of the lantern is placed a circular revolving map, embracing the portion of the northern heavens within a radius of fifty degrees of the north pole. This is adjusted to the place of study by inserting an artificial horizon, which covers up as much of the map as represents the part of the heavens hid by the earth at the corresponding latitude. It is adjusted to the time of study by revolving till the correct time appears on the dial of the indicator. The eastern map, on the western side of the lantern, represents the belt of the heavens lying between the celestial equator and the margin of the northern map. It is virtually endless, and rolled on frustums of cones past an open window, in which is seen the portion of this belt representing the eastern heavens at the precise time for which the map is set. By a revolution of the map itself, it is set so that the stars will rise at the correct angle with the horizon for any latitude. A similar map, provided with similar adjustments on the eastern side of the instrument, represents this same belt of the heavens as it sets in the west. The entire southern hemisphere, upon a smaller scale, is placed on the northern side, and through a crescent shaped window is seen the portion of it visible at any northern latitude, the outer curvature of the crescent showing the location of the celestial equator, and the inner curvature representing the entire southern horizon from due east to due west. Each map is provided with an attachment for determining exact position, in lieu of a net-work of lines on its face. The entire construction of the instrument is so simple, and its adjustments so easy, that the merest tyro can understand and use it intelligently.

Storage of Electricity.—The secret of devising methods by which electricity may be stored up and given out at will when required for useful purposes, appears to be in a fair way of being discovered before we are much older. In this most interesting and promising field of study the French have taken the initiative, and have already made great progress in developing the subject to the condition of practical usefulness.

We have already noticed in our columns the several efforts made in France to apply the Faure secondary battery to practical uses, and commented on the successful transmission of a number of these batteries charged with a million foot-pounds in the form of stored electrical energy, from Paris to Glasgow, without appreciable loss. This evidence of the pro-

gressing managability of the storage battery may now be supplemented by a similar shipment of a number of storage batteries from Paris to New York, where an agency for the introduction of the Faure system has been established.

The facts of the case, as recorded in the daily journals, are substantially as follows: The agents of the Light and Force Company, of New York, arrived in this city on the morning of May 12th, in the French steamship "Labrador." They brought with them eighty large accumulators or storage batteries, weighing 125 pounds each, and capable, when charged, of giving out power at the rate of one horse-power for one hour, or at any slower rate that may be required, as, for example, one-tenth of a horse-power for ten hours. They also brought sixty-five smaller accumulators, weighing 40 pounds, and capable of giving out one-third of a horse-power for one hour.

All of these batteries were charged in Paris ten days before the "Labrador" left Havre, and have not since been recharged. On the voyage here, a number of Edison lights were run by the current from thirty of the large batteries coupled together; and as regards the light furnished, the statement is made that they afforded a steadier light than it is possible to obtain from the dynamo-machine.

ARTIFICIAL QUININE.—Since the eradication of the long prevalent error that organic compounds required the aid of a vital force to produce, numerous and valuable discoveries in the artificial production of such compounds in the laboratory, have been made. One of the favorite subjects for experimentation among chemists has been the artificial production of quinine.

This subject is now attracting a large share of attention from the fact that it has been lately asserted that the problem has been solved, and that the methods of procedure would shortly be made public. The fact is, that a new substitute for quinine has been prepared synthetically, and the effort is being made to introduce it. It is asserted by some, however, that the new quinine is not identical with the natural substance, but resembles it closely, and has the same therapeutical effects. It is suggested that it is probably *chinoline*, which has lately been artificially produced, in view of which a brief review of its history and properties may be of interest.

The following facts bearing upon the subject we glean from the Boston *Journal of Chemistry:* In 1842, Gerhardt obtained a new base by distilling quinine and other alkaloids with potash, and gave to it the name of *quinoleine*. A few years later, A. W. Hofmann showed that quinoleine was identical with one of the bases which Runge had discovered in coal tar, and to which the latter had given the name of *leucol*. Laurent afterwards found that Gerhardt's quinoleine was not perfectly pure, and Williams doubted its absolute identity with leucol. In 1880, Skraup succeeded in making chinoline, as it is now called, by heating a mixture of aniline oil, nitro-benzole and glycerine with sulphuric acid. This seems to have been the reason why attention was directed anew to this long but imperfectly known substance.

Chinoline is an oily liquid, of strong refractive power, and possessing a peculiar odor. It boils at 228° C. (442° Fah.), and, when freshly prepared, is colorless, but soon darkens like aniline, without undergoing any chemical change. The free base is not soluble in water, but dissolves readily in alcohol, ether, chloroform, benzole, etc. Its salts are deliquescent and difficult to crystallize, with the exception of the tartrate. This salt has a faint odor of bitter almonds and a burning taste like peppermint water.

Donath has studied its antiseptic and physiological properties with extreme care and thoroughness. He finds that chinoline has distinct antiseptic, antizymotic and antipyretic properties; in 0.2 per cent solutions it prevents the putrefaction of urine, of glue, and the lactic acid fermentation; in 0.4 per cent solution, it arrests completely the putrefaction of the blood, and hinders in the highest degree the coagulation of milk; and, finally, in 1 per cent solution, it prevents the coagulation of the blood. Numerous experiments upon healthy as well as sick persons have shown that chinoline in large doses (15 to 30 grains per day) can be taken without injury. Most of the experiments made with tartrate of chinoline in malarial diseases, intermittent fevers of different types and duration, intermittent neuralgia, and similar complaints, are reported as having been satisfactory. None of the inconveniences attendant upon the use of quinine, such as a ringing in the ears, dizziness, and loss of hearing, are noticed with chinoline. Dr. Loewy reported over forty successful cases in the Vienna *Medical Press*. Dr. Sakowsky, in St. Petersburg, also gives a favorable report in regard to it. We hope soon to hear what success has attended its use in this country, but at the same time we advise great caution in using it until its action and properties are better understood than at present.

THE LIGHTNING ROD CONFERENCE lately held in England, was composed of representatives from the Meteorological Society, the Royal Institute of British Architects, the Physical Society, and the Society of Telegraphic Engineers. This body of delegates has just issued a report which is of considerable public interest. The subject matter of the report is treated of under three heads: (1) The purpose which a lightning rod is intended to serve; (2) a statement of disputed points in the construction and erection of lightning conductors, and the decision of the conference thereupon; and (3) a code of rules for the erection of lightning conductors. The conference laid down the following rules respecting the minimum dimensions of rods: Copper—rope, ½ inch diameter; round rod, ⅝ inch; tape, ¼ inch. Iron—round rod, $^{9}/_{10}$ inch. The weight of the last named will be 35 ounces to the foot, while none of the copper materials will exceed 7 ounces to the foot. The conference gives its adherence to copper as the cheapest and best material for the purpose which a lightning rod is intended to subserve.

The following points respecting the manner of constructing and erecting a lightning rod are of interest: The rod recommended by the conference has no terminal points, but the rod itself is carried to the full hight, and then simply beveled off at its summit. Some distance below the upper terminus, say about a foot, a copper ring is soldered, which carries three or four needles of copper 6 inches long, and tapering from ¼ inch in diameter to as fine a point as possible; and it is recommended that these points be platinized, gilded or nickel-plated. The purpose of this modification of the usual plan of surmounting the tip of the rod with points, is stated to be to give the rod the greatest possible electrical conducticity, while the points below will effect the silent discharge, as with the usual arrangement. Gilding or platinizing of the points is preferred to nickel-plating, in towns and cities, because of the corrosive action of sulphurous gases always present where large quantities of coal are consumed, and which would, it is thought, speedily destroy the thin coating of nickel. The report of the conference embraces some novel recommendations respecting the earth connection of the rod, which may form the subject of a separate paragraph.

Respecting the area protected by a lightning conductor, the report contains the interesting statement that, save in two doubtful cases, there is no recorded instance of a building being struck within a conical space the radius of whose base is equal to the hight of the rod. This last estimate conforms to the view generally entertained by scientific men on the subject.

AMMONIA FROM THE NITROGEN OF THE AIR.—Many efforts have been made by chemists, with indifferent success thus far, to produce ammonia by utilizing the atmospheric nitrogen. We lately described an English process intended to accomplish this object, and may now add another from a French source which looks very reasonable on its face. The process is thus described: In this operation metallic zinc is employed to set free the elements involved in the reactions, and titanic iron to effect their union. Molten zinc falling into a body of water liberates hydrogen, oxide of zinc being formed. A stream of air passed over spongy titanic iron results in the absorption of the atmospheric nitrogen; and when the hydrogen liberated in the above named reaction is passed through retorts containing this spongy iron, the nitrogen is liberated from the titanium and unites with the hydrogen to form ammonia. The oxide of zinc formed in the reaction is afterwards reduced in retorts by mixing with carbon and heating and distilling in the usual way, and the carbonic oxide formed in the operation is burned to carbonic acid, and made to unite with the ammonia to form the carbonate. Or, in place of using the spongy iron, platinized pumice or charcoal is substituted for it, and the gases are made to act upon it under moderate pressure.

THE HOLY WELL OF MECCA affords Prof. Frankland the opportunity of setting forth in the London *Times*, in a very convincing manner, the way in which superstition aids in the spead of that frightful scourge of humanity, called "Asiatic cholera." This well is regarded as sacred by the followers of Mohammed, and the manner in which it serves the purpose of spreading disease is thus set forth in the article referred to: "The well is in Mecca; the water is regarded as holy, and large quantities are annually sent as gifts to all Mussulman countries. Most of the Mohammedan princes, especially those of India, have 'keepers of the well,' whose duty it is to send them annually water from it. I have analyzed this water, and find it to be of the most abominable character. In fact, it is sewage more than seven times as concentrated as London sewage, and it contains no less than 579 grains of solid matter per gallon. Knowing the composition of this water, and the mode of propagation of Asiatic cholera by excrementitious matters, it is not to be wondered at that outbreaks of this disease should often occur among pilgrims to Mecca, while it would scarcely be possible to provide a more effective means for the distribution of cholera poison throughout Mohammedan countries."

TELEGRAPHIC STATIONS IN MID-OCEAN.—An ingenious Frenchman, M. Menuissier, makes the following suggestions for a series of telegraphic stations in mid-ocean, with the aid of which vessels could communicate with the mainland. He proposes to lay a cable for the purpose (say from Bordeaux to New York), with a branch in mid-ocean to Panama. At intervals of every 150 or 200 miles he would connect with this a vertical cable, the location of which would be distinguished by a buoy at the surface, in which it would terminate. He proposes, further, to lay to the right and left of the main cable, at intervals of 30 or 60 miles, branch cables, connected with the main cable and terminating likewise in buoys at the surface, so that the chance of vessels sighting them would be frequent. Vessels provided with telegraphic apparatus would then have no difficulty in placing themselves in communication with the mainland.

A NEW ANTISEPTIC.—Prof. Barff, whose name will be familiar to many of our readers in connection with his process of preserving iron, has lately devised a new antiseptic compound, to which he has given the name of "boroglyceride." It consists, as we are advised, of a solution of boracic acid in glycerine. The proportions of the materials are said to be 62 parts of the former to 92 of the latter. The solution is effected by the prolonged action of heat upon the ingredients, the temperature being maintained a little short of the boiling point of the glycerine. The solution is represented as having powerful antiseptic properties. For ordinary purposes, one part of the boroglyceride in 40 parts of water is recommended

Vision.

[*Continued from page* 91, *April Number.*]

Continuing our extracts on this subject, from the excellent manual of Messrs. Queen & Co., we will next discuss the topic of imperfect sight resulting from age, physical weakness, or injuries. Of these, the first in order is:

Presbyopia.—"Old-sight," "far-sight," or "presbyopia," as it is variously called, is a physiological defect depending upon the hardening of the lens of the eye so that it can no longer change its shape to the same extent as in former years. This process of hardening begins quite early in life and gradually increases, but in natural eyes causes no inconvenience until middle life—from the 40th to the 45th year—when it will be found difficult or impossible in ordinary light to longer see the eye of a cambric needle, or to read diamond type nearer than 8 inches from the eyes. At this point presbyopia is said to begin, and, for comfortable use of the eyes by gas-light, it is found necessary to use a weak convex glass to assist the lenses of the eyes in focusing rays of light upon the retina. In the hypermetropic and astigmatic eye, presbyopia begins at a much earlier age. Persons with properly shaped eyes cannot hope to avoid the inconvenience thus occasioned, nor will they retain their "young sight" longer by avoiding the use of glasses. The popular impression in this regard is erroneous, and in deferring the use of their first glasses they are subjecting themselves to unnecessary discomfort.

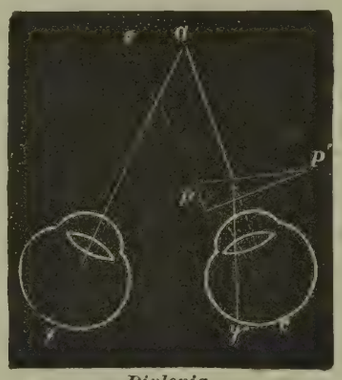
As the office of the glass is to supply the refracting power which the eye, through age or malformation, cannot furnish, it is evident that so soon as a need of this artificial power is felt we should resort to it. By failing to do so, we deprive ourselves of much useful work of the organ, while the work it does is done under a disadvantage, and with greater or less risk of permanent and painful injury, more especially when the eyes are imperfectly formed. Those who are able to put off the use of glasses longer than the 45th year, and still maintain distinct vision for reading fine print, have probably always been slightly near-sighted, and may find their distant vision improved by a weak near-sighted glass. Many persons have this defect in low degree without ever being conscious that they do not see as well as other persons.

When presbyopia, or old-sightedness, commences, inconvenience will first be felt in the use of the eyes in the evening, and for a year or more one may confine the use of his glasses to work at that time. But they will soon become necessary during the day, especially if they have work requiring close and accurate attention, and the light is not good.

Under ordinary circumstances—that is, when there is no myopia, hypermetropia or astigmatism, and when the eyes are in other respects healthy, the first glasses should be weak—say about No. 60, according to the numbering in this country. Such a number, however, should be selected as will enable the reading the finest print at twelve inches. After the lapse of a year or two it will be found necessary to increase the number of the glasses to about 48; these will then serve both for evening and day work. As regards the frequency with which the glasses have to be changed, it differs in different individuals. As a general rule, however, they should be increased as much as the individual case may demand—probably every two to five years, always keeping the "near point" of good, clear vision at about twelve inches. The general health will influence this largely; the weak, nervous woman feeling the need of an increase in the strength of her glasses much sooner than a robust, healthy man. Those who use their eyes much, especially if at trying work, will also experience a demand for a more frequent change.

Diplopia, or Double Vision.—To insure correct and comfortable vision the two eyes must work in unison, for if the rays of light do not fall on a corresponding spot of the retina of each eye, two objects instead of one will be seen. Diplopia, or double sight, is caused by weakness of the muscles which move the eye from side to side. They are no longer able to hold the two eyes steadily fixed toward the object, and the eye moving out or in, causes the individual to see the object double. This can often be very much relieved by prismatic lenses.

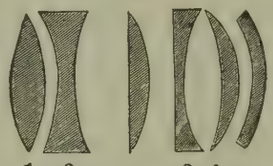
Paresis of the Ciliary Muscle is the inability to maintain the adjustment of the eyes for near objects any length of time without fatigue; for instance, in reading or sewing, especially by insufficient light, the fatigued ciliary muscle relaxes and the accommodative power of the eyes is suddenly lost, causing the print or work to become confused and unintelligible, together with a feeling of fatigue and pain about the eyeballs. In such cases, after a few minutes' rest and closing the eyes, work can be resumed but for a short time only, as the muscle will again lose its strength



Diplopia.

and relax. This disagreeable trouble arises from a debilitated condition of the whole system, which, though not felt in other parts of the body, is apparent in the muscle of accommodation, on account of its position and the character of the work it is called upon to perform. After a fit of illness, or a great shock causing nervous prostration, this difficulty is often apparent.

Persons whose eyesight had been previously perfect



1.—Double Convex. 2.—Double Concave. 3.—Periscopic Concave. 4.—Periscopic Convex. [The numbered figures are spectacle lenses.]

should not resort to glasses of any kind when affected with these spasms of the sight, but wait patiently until nature does the work by restoring the tone of the whole system. This advice does not apply to those who have this same trouble when it arises from a hypermetropic form of the eye, and not from the cause mentioned above. A skilled oculist, on examination, would at once detect the cause, and prescribe the remedy.

Cataract is a term used to denote the gradual loss of sight arising from the lens of the eye becoming turbid. At the proper time the lens is removed by an oculist, after which very strong convex lenses will restore the vision.

There are many other causes that produce defective sight, but they arise from a diseased condition of the coatings or other parts of the eye, and are only remedied by medical treatment.

Lenses for Correcting the Optical Defects of the Eyes.—A lens is a transparent substance having one or both faces ground to a curved form and polished. Rays of light, in passing through a lens, are bent from their original straight course; convex lenses concentrate the light to a focus and form pictures; a concave lens disperses the light and will not form a picture. Spectacle lenses are called double convex, periscopic convex, double concave, periscopic concave, plano-cylindrical, and sphero-cylindrical. Double convex and periscopic convex lenses are required for giving perfect sight to hypermetropic and presbyopic eyes. Double concave and periscopic concave lenses are required to correct the defective vision of myopic eyes. The periscopic form is rather the best, simply because the inner surface corresponds more nearly with the convex curve of the cornea. Persons who have accustomed themselves to the use of either one of these forms should adhere to that one, and not change, as the eyes will not feel natural until the muscles of convergence of the two eyes have acquired the habit of adjusting the eyes to the changed form of the inner curve of the lens.

A cylindrical lens has the curved surface, a section of a hollow cylinder, and not a section of a sphere. Such lenses are applied to astigmatic eyes to correct the irregular curvature of one axis of the cornea. When myopia or hypermetropia is found to exist in addition to astigmatism, a proper spherical curve is ground on the opposite side of the same lens. Such a lens is called sphero-cylindrical. Cylindrical lenses require great care, when being set in frames, that the axis of the cylinder be at the required angle for correcting the astigmatism of the cornea. None but a good workman of long experience can do it successfully. The material of which lenses are made are crystal—Brazilian quartz—commonly called pebbles, or white glass.

Pebble lenses possess the advantage of being extremely hard, and do not scratch or break readily. They bear a much higher polish than glass, and are more refractive, and therefore not so thick. Next to pebbles, fine white crown glass is a good material for spectacle lenses, and the lenses found in ordinary spectacles are made of it. Traveling vendors of spectacles are very apt to impose ordinary glasses for pebbles upon those whom they may persuade to buy their wares.

Great care should be observed in setting the lenses in spectacle or eye-glass frames, that the optical center of the lens corresponds with the center of the eye, because the lens becomes a prism when its optical center deviates from the center of the spectacle eye. Such spectacles are very injurious to the eye.

Concave lenses should be brought as close to the eye as the eyelashes or eyelids will admit, and be in such a position before the eye that the center of the lens will be directly opposite the pupil when the attention is directed to distant objects. There should be no forced inclination of the head backward to accomplish this result. Convex lenses should be placed at about three-quarters of an inch from the eyes, and at such an angle to the line of the face as will bring the axis of the lens and the axis of the eye, when directed to close objects, directly in one line. When the eyes are exceedingly sensitive to bright light, such as sunlight reflected from snow or white sand, or the white page of a book, colored glasses should be worn, but care should be taken to remove them instantly as soon as they cease to be exposed to the irritating influence. For cleansing the lenses, use a piece of old soft cotton cloth. Silk, linen and paper are all liable to scratch the glass.

Spectacles and Eye-Glasses.—The important parts of a perfect pair of spectacles are the sides or temples, the nose-piece or bridge, and the lenses. The sides should be elastic, and yet firm enough to hold the lenses securely and correctly to their position before the eyes. The nose-piece should be of the proper length, and its curve of the right depth, so that the center of each lens shall be opposite the pupil of the eye. For reading spectacles the curve of the bridge should be deep, and the bridge at the curve bent out from line of the lenses. For distant sight the curve of the bridge should be quite shallow, and not bent forward from line of lenses. In order to bring the surface of the lenses at right angles to the axes of the eyes, when the spectacles are on the face, a plan has been devised of setting the sides at an angle with the line of the lenses, and works admirably. The important parts of an eyeglass are the form

of the eye, the spring, and the lens. The oval form is best suited for the eyes, as it is impossible with any other shape to have the centers of the lenses to correspond or be opposite the pupils of the eyes. The spring, or bridge, must be of the form and strength that will in each case fit the nose and maintain the lenses in their proper position before the eyes.

Building Intelligence.

Architects, Builders and Contractors are invited to send us items of interest for this department. It is our object to notice only the more important operations in building, our space being too limited for the publication of minor matters, which, besides, possess only local interest. We wish to publish only such intelligence as is of general interest.

New York City Building Items.

Grosvenor P. Lowery is to build a ten story and attic apartment house at Madison avenue and Thirtieth street, which will cost $300,000.

Oliver Ditson & Co., have filed plans for the erection of a five story brick building at Eighteenth street and Broadway, to cost $130,000.

Parke Godwin is to erect, at a cost of $200,000, a seven story office building at Nassau and Liberty streets. It is to be called the Bryant Building.

At No. 16 East Fifty-third street, an apartment house for bachelors, five stories high and brown stone front, is to be built from designs by Geo. E. Harney.

The corporation of Trinity Church proposes erecting a seven-story warehouse at 440, 442 and 444 Canal street, to run through to Vestry street, at a cost of $110,000.

In Eighty-seventh street, the Rhinelander estate is about to put up a number of 18-feet dwellings, three and four stories in hight. George Martin Huss is the architect.

General Daniel E. Sickles has taken a lease of the property at the northeast corner of Fifth avenue and Ninth street, formerly occupied by the Northern Pacific Railroad Company, and will build an apartment house there.

Plans have been filed for the erection, by the Delaware, Lackawanna and Western Railroad Company, of a freight depot at the foot of Leroy street, North River, to be 78 feet front by 556½ feet deep, and to cost $50,000.

Hubert, Pirsson & Co. have completed plans for an apartment house to be built on the northeast corner of Madison avenue and Thirtieth street. It is to be 91 by 110 feet, to have ten stories and attic, brick and stone front, and will cost $300,000.

Alfred H. Thorpe is engaged on the plans for a new hotel at Richmond Beach, Staten Island. The south wing will be opened this summer. When completed, the hotel will be four stories high, 130 by 400 feet, and will cost $60,000.

Plans have been filed by the trustees of the German Lutheran church for a place of worship on the south side of One Hundred-and-Fiftieth street, 100 feet east of Robinson avenue, to be one-story, with a tower on top; to be 30 feet front by 70 feet deep, and to cost $2,500.

D. T. Atwood will shortly commence the preliminary sketches for a very extensive hotel, to be erected at Mount McGregor, to contain 400 rooms. A two-story frame hotel, 60 by 108 feet, in the Renaissance style, and which is to cost $20,000, has recently been commenced at the same place.

Plans have been filed by the Mayor, Aldermen and Commonalty, and the Board of Health, for the erection of a building to be used as a hospital for contagious diseases, on North Brothers Island. The building is to be 160 feet front, the depth of the main portion 44 feet 8 inches, and the wards 32 feet 8 inches. The cost will be $67,000.

W. H. Hume is engaged on the plans for the erection of an iron front store and office building, at 3 West Fourteenth street. There will be a projecting bay-window on the first floor, with plate glass windows and stained glass transoms. The front of the upper stories will octagonal in form. The owner is George Hillen.

On Hart's Island, a central administration building, 36 by 60 feet, with two wings 30 by 150 feet each, to cost about $50,000, is to be built of brick and stone; and on the same island, a laundry and kitchen building, 40 by 80 feet, of native stone with brick trimmings, is to be built at a cost of $20,000. Both are from designs by Jos. M. Dunn.

H. H. Cooke is erecting a handsome residence at Fifth avenue and Seventy-ninth street. Its first story, which is finished exteriorly, shows the kind of work that is be done throughout. It is of granite of varied colors, hammered and rock faced, and the treatment is such as to yield the effects that are given by a blending of brick and stone. The house is to be absolutely fire-proof.

The plans for the Vanderbilt residences to be erected on Fifth avenue and Fifty-fourth street, are nearly perfected. The house on the corner has a frontage of 48 feet, and the adjoining one 52 feet. The houses are to be four stories, with steep roofs crowned with copper crestings and finials. The fronts will be of brick and stone, the first stories being entirely of stone. Charles B. Atwood is the architect, in conjunction with John B. Snook.

Carl Pfeiffer has prepared plans for the erection of an eight-story brick and brown stone apartment house on the northwest corner of Eighth avenue and Sixty-second street by a coöperative association. It will be fire-proof and have a passenger elevator and two servants' elevators. The first seven floors will have two suites of apartments, while the eighth will have three. The ninth floor will be used for servants' rooms and storage purposes. The cost will be $250,000.

Henry Villard proposes to build upon the block back of the Catholic Cathedral on Fifth avenue a crescent of handsome dwelling houses facing on Fiftieth street, between Madison and Fourth avenues. In the middle of the block the houses will stand far back from the street, approaching it at either end. The open space in front will be a garden, to be enjoyed in common, and to be adorned with fountains and statuary, as well as plants and flowers. The work of excavating the rock, which is even with the surface, is under way.

Jared B. Flagg, Louis L. Todd and Augustus Hatfield are the incorporators of a company who propose to erect a very extensive six-story, fire-proof apartment house on the plot of ground on the south side of Eighteenth street, west of Fifth avenue, 53 feet by half the block, to be known as No. 12 West Eighteenth street. The house will be divided into four sections—A, B, C and D. The plans were designed by Augustus Hatfield, and it is estimated that the cost will be $120,000.

R. M. Stivers will build a four-story and basement brick carriage repository in the rear of the lot on the north side of Thirty-first street, 140 feet west of Lexington avenue, 42 feet 2 inches by 35 feet 3 inches by 39 feet 1½ inches by 42 feet 2 inches, irregular. It will have heavy walls and wooden girders and beams. The basement floor will be used for stable purposes. There will also be a carriage elevator. The architect is George Martin Huss.

Abraham Benton proposes to erect a magnificent eight-story apartment house on the irregular plot of ground just purchased by him on the northeast corner of Broadway and Sixty-second street, 116 feet 2 inches by 139 feet 11 inches by 100 feet 5 inches by 87 feet 1 inch. The building will be thoroughly fire-proof throughout and contain every modern improvement. A Russian bathing establishment and safe deposit vault will be introduced in this structure. There will also be two elevators. It is said that the cost of this fine improvement will be nearly $500,000.

W. H. Hume has completed the plans for a magnificent mausoleum to be erected at Cypress Hill by the Seligman family. It will be of granite, hexagonal in form, and capped by a granite dome surmounted by a bronze ornament of appropriate design. One side of the hexagonal forms the entrance porch, which has polished granite columns and solid wrought bronze gates and transoms, behind which appear the polished granite doors folding into the recesses on either side of the vestibule. From the rear face is a projection to contain a very handsome stained glass window. The four remaining sides have projections, each of which contain ten catacombs. Entering the vault, which maintains the hexagonal form, we find the chamber entirely finished in marble, including the dome. All the interior will be of white Italian marble, except the trim, columns and groining of the dome, which will be of richly colored Levanto marble. A peculiar feature is found in the circular windows, which on the exterior appear in the vertical walls above the roof of the catacombs, but which on the interior are pierced through the dome, thus producing a soft flood of light in the upper part of the rotunda. The cost of this structure will be about $40,000.

Among the numerous large and costly buildings which have been erected in this city during the past two or three years, is one on the corner of Franklin street and West Broadway, which has just been completed for Francis H. Leggett & Co., wholesale grocers. It has a frontage on Varick street of 86 feet 4 inches, 89 feet 7 inches on Franklin street, and 74 feet 3 inches on West Broadway. The building is irregular in shape, covering an area of four city lots, is nine stories high, exclusive of the cellar, and is built of Trenton pressed brick. The entire first story on all three streets is of rock-faced Hallowell granite, cut with a batter of 10 inches, giving the building a remarkably solid and massive appearance, which is further enhanced by the heavy buttress piers above, and the heavy granite sills and lintels of the windows. The granite work was done by the Hallowell Granite Co., of Maine. The ninth story is in the French roof extending around the entire building, with the exception of the corner of Franklin street and West Broadway, which is occupied by a granite tower with an iron roof, filled in with fire-proof blocks, and slated. The top of this tower is 150 feet above the curb, and the building itself is 120 feet high. One of the features of this structure is the cellar, the finished floor of which is 3 feet below tide-water. In sounding for bottom, the builder found first a layer of earth, then one of sand, under which were the remains of a forest of cedars that at one time had evidently stood there; this was followed by a layer of jelly-like clay, and finally a gravel botom, down to which the piles were driven. There are 1,200 of these, ranging in length from 9 feet up to 22 feet. Considerable difficulty was experienced with the water, but this was obviated by the liberal use of cement concrete. The cellar floor is of concrete, 2 feet thick; and is now perfectly dry. The vault extends to the curb on all three streets, and is covered with large granite slabs 12 inches thick; the patent light stoop runs around the entire building, and is 5 feet wide. The interior of the building is in the same massive style which characterizes the outside, the timbers being 4 by 14 inches, placed 14 inches from centers, and carried on 14x14-inch girders, all of Georgia pine. The girder piers in the cellar are of granite, many of them being in one stone. The first and second story girders columns are of iron, and above that they are of white oak 14 inches square. Each floor is able to carry 1,000 pounds to the square foot. There are five of Otis's steam elevators in the building, the engines for which are placed on the fifth floor. The boilers for running the elevators, electric light machine, and heating, are of 100 horse-power, and are located in the vault on Varick street. The offices and sales-rooms occupy the entire second story, which is handsomely fitted up. The building cost, exclusive of the ground, $230,000; the ground cost $100,000. The mason for this job was John Kelcher; the carpenter, John Smith; contractors for the iron-work, Blake and McMahon; and the architect, Geo. W. da Cunha, of 111 Broadway, this city.

Market Report of Building Materials.

NEW YORK PRICES.

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LUMBER.

Pine, very choice and extra dry, ₱ M	$60 00 @ 70 00
Pine, good	55 00 @ 60 00
Pine, shipping box	21 00 @ 22 50
Pine, common box	18 00 @ 20 00
Pine, common box ⅝	16 00 @ 18 00
Pine, tally plank, 1¼, 10 inch, dressed each	— 44 @ — 50
Pine, tally plank, 1¼, 2d quality	— 35 @ — 38
Pine, tally plank, 1¼, culls	— 28 @ — 30
Pine, tally boards, dressed, good	— 30 @ — 32
Pine, tally boards, dressed, common	— 25 @ — 28
Pine, tally boards, culls, dressed	— 23 @ — 25
Pine, strip boards, merchantable	— 18 @ — 20
Pine, strip boards, clear	— 24 @ — 26
Pine, strip plank, dressed, clear	— 33 @ — 35
Spruce boards, dressed	— 25 @ — 27
Spruce plank, 1¼ inch, dressed	— 28 @ — 30
Spruce plank, 2 inch	— 43 @ — 45
Spruce wall strips	— 15 @ — 16
Spruce timber, ₱ M	20 00 @ 25 00
Hemlock boards, ₱ M	17 00 @ 18 00
Hemlock joist, 2½x4, each	— 16 @ — 17
Hemlock joist, 3x4	— 18 @ — 20
Hemlock joist, 4x6	— 40 @ — 44
Ash, good, ₱ M	55 00 @ — —
Oak	60 00 @ 65 00
Maple culls	25 00 @ 30 00
Maple good	45 00 @ 50 00
Chestnut	48 00 @ 52 00
Cypress, 1, 1½, 2, and 2½-inch	35 00 @ 40 00
Black Walnut, good to choice	115 00 @125 00
Black walnut, ⅝-inch	85 00 @100 00
Black walnut, selected, and seasoned	150 00 @175 00
Black walnut, counters, ₱ ft	— 22 @ — 28
Cherry, wide, ₱ M	100 00 @120 00
Cherry, ordinary	60 00 @ 80 00
White wood, inch	45 00 @ 50 00
White wood, ⅝-inch	35 00 @ 40 00
White wood, ⅝ panels	45 00 @ 50 00
Shingles, extra sawed pine, 18-inch	4 00 @ 5 00
Shingles, clear sawed pine, 16-inch	3 75 @ 4 00
Shingles, cypress, 24x6	18 00 @ 20 00
Shingles, cypress, 20x6	10 00 @ 12 00
Lath, Cargo rate	2 10 @ — —
Yellow dressed pine flooring	30 00 @ 40 00
Yellow pine girders	32 50 @ 40 00
Locust posts, 8 feet, ₱ inch	— 18 @ — 20
Locust posts, 10 feet	— 24 @ — 25
Locust posts, 12 feet	— 29 @ — 34
Chestnut posts, ₱ ft	— 3 @ —3½
Basswood ₱ M	25 00 @ 30 00

Cargo rates 10 ₱ cent off.

CEMENT—PER BARREL.

Portland (imported)	2 65 @ 2 85
Portland (American)	2 50 @ 2 75
Portland (Lafarge)	3 30 @ 3 65
Lime of Teil	2 30 @ 2 50
Lime of Teil, ₱ ton	15 00 @ 18 00
Roman	2 75 @ 3 25
Keene's & Martin's, coarse	6 00 @ 6 50
" fine	10 50 @ 10 75
Rosendale	1 10 @ 1 20

SOLDERS.

Half and half	15½ @ — 15¾
Extra	14½ @ — 14¾
No. 1	13 @ — 13¼

ZINC.—Duty, sheet, ₱ ℔, 2½ cents.

Sheet (cask) ₱ ℔	7⅞ @ — 8
Sheet (open)	8¼ @ — 8½

BRICKS.

	Cargo.		Afloat.
Pale, ₱ M	4 00	@	5 00
Up Rivers	5 25	@	6 00
Jersey	5 25	@	6 00
Haverstraw Bay	5 25	@	6 00
" " choice	6 87½	@	7 00
Favorite Brands	7 25	@	— —
Hollow Fire-Clay Brick	9 00	@	9 25

FRONTS.

Croton—Brown, ₱ M	12 00	@	— —
" Dark	14 00	@	— —
" Red	14 00	@	— —
Philadelphia	35 00	@	— —
Trenton	35 00	@	— —
Baltimore	45 00	@	— —
Clark's Glens Falls, White	30 00	@	— —
" " Red Fronts	27 50	@	— —
" " Molded Red and White	45 00	@	80 00

Yard prices 50 cents ₱ M higher, or with delivery added $2 ₱ M for hard and $3 ₱ M for front brick. For delivery add $5 on Philadelphia, Trenton and Glens Falls and $6 on Baltimore brick.

STONE.—Cargo Rates Delivered in New York.

Amherst Sandstone, No. 1, buff, in rough, ₱ c. f.	1 00 @ — —
do do No. 2	— 85 @ — 95
Bedford Stone	1 25 @ — —
Berlin Freestone, in rough	— 75 @ 1 00
Berea Freestone, in rough	— 75 @ 1 00
Brown Stone, Portland, Conn.	1 00 @ 1 35
Bay of Fundy Wood Point Brown Stone	1 00 @ — —
do Mary Point Brown Stone	1 00 @ — —
do do Olive Stone	1 00 @ — —
Brown Stone, Belleville, N. J	1 00 @ 1 35
Granite, rough	— 60 @ 1 25
Canaan Marble	1 25 @ 1 50
Sutherland Falls Marble	1 25 @ 1 75
Dorchester, N. B., Stone, rough, ₱ foot	1 00 @ — —

LEAD—PER 100 POUNDS.

German	— — @ — —
English, common	— — @ — —
Spanish	5 75 @ — —
Foreign, refined	— — @ — —
Bar	6 50 @ — —
Sheet	7 50 @ — —
Pipe	— @ — —
Domestic	4 63 @ — —

TIN PLATES.—Duty, 1 1/10 cents ₱ ℔.

I. C. charcoal, 10x14, ₱ box	6 25 @ 6 50
I. C. coke, 10x14	5 25 @ 5 75
I. X. charcoal, 10x14	8 25 @ 8 37½
I. C. charcoal, 14x20	6 25 @ 6 50
I. X. charcoal, 14x20	8 25 @ 8 37½
I. C. coke, 14x20	5 25 @ 5 75
I. C. coke, terne, 14x20	5 25 @ 5 37½
I. C. charcoal, terne, 14x20	5 50 @ 5 75

NAILS—PER KEG.

10d to 60d, common, fence and sheathing	3 30 @ 3 40
8d and 9d, common	3 65 @ — —
6d and 7d, common	3 90 @ — —
4d and 5d, common	4 15 @ — —
3d and 4d, light	4 95 @ — —
3d, fine	5 65 @ — —
2d, fine	5 65 @ — —
Cut spikes, all sizes	3 65 @ — —
Clinch nails, 1½ to 1¾ inch	5 65 @ — —
do. 2 to 2½ inch	5 40 @ — —
do. 2½ to 2¾ inch	5 15 @ — —
do. 3 inch and longer	4 90 @ — —

IRON—PER TON.

Duty.—Bar, 1 to 1½c. ₱ ℔. ; Railroad, 70c. ₱ 100 ℔. ; Boiler and Plate, 1½c. ₱ ℔. ; Sheet, Band, Hoop, and Scroll, 1¼ to 1¾c. ₱ ℔. ; Pig, $7 ₱ ton ; Polished Sheet, 3c. ₱ ℔. Galvanized, 2½c. ₱ ℔. ; Scrap cast, $6 ₱ ton ; Scrap Wrought, $8 ₱ ton—all less 10 ₱ cent. No Bar Iron to pay a less duty than 35 ₱ cent ad val.

Pig, Scotch—Coltness	25 50 @ 26 00
" Glengarnock	24 00 @ 24 50
" Eglinton	22 50 @ 23 50
" American, No. 1	24 50 @ 25 50
" American, No. 2	23 00 @ 24 00
" American forge	22 00 @ 22 50

PAINTS.

Carmine, American, ₱ ℔	5 00 @ 5 25
Chalk, ₱ 100 ℔s	— 35 @ — —
China Clay, ₱ ton	18 00 @ 20 00
Chrome yellow, dry, ₱ ℔	— 12½ @ — 28
Lead, red American, ₱ ℔	— 6¾ @ — 7
Lead, white American, pure, in oil	— 7½ @ — 8
Lead, white American, pure, dry	— 6¾ @ — 7
Lead, white English, pure, in oil	— 9 @ — 10
Litharge	— 6¾ @ — 7
Ocher, Fr., dry, ₱ 100 ℔s	1 50 @ — —
Ocher, ground, in oil, ₱ ℔	— 6 @ — 15
Ocher, Vermont, ₱ 100 ℔s	— 75 @ 1 00
Orange Mineral, English	— 9 @ — 10
Paris White, American	— 1½ @ — 1¾
Paris White, English, prime	— 2 @ — 2¼
Paris Green	— 15 @ — 28
Plumbago paint, patent, ₱ ℔	— — @ — 25
Putty, ₱ ℔	— 2 @ — 2½
Spanish Brown, dry, ₱ ℔	— 1⅛ @ — 1¼
Spanish Brown, ground in oil, ₱ ℔	— 8 @ — 9
Venetian red, ₱ cwt	1 75 @ 2 00
Vermilion, Chinese, ₱ ℔	— 85 @ — 90
Vermilion, Trieste	— 70 @ — 75
Vermilion, quicksilver, bags	— 50 @ — 52½
Vermilion, American, common	— 15 @ — 18
Whiting, ₱ 100 ℔s	— 60 @ — 80
Zinc, white American, dry, No. 1	— 5 @ — 7½
Zinc, white American, No. 1, in oil	— 8 @ — 10
Zinc, white French, dry, (Red Seal,)	— 7 @ — 8
Zinc, white French, in oil	— 10 @ — 10½

VARNISHES—PER GALLON.

American Wearing Body	3 50 @ 4 00
Coach Body	2 35 @ 3 50
"	1 80 @ 2 00
Furniture	1 25 @ 2 50
Black Asphaltum	1 00 @ 1 50
Brown Japan	1 00 @ 1 20
Liquid Paint Dryer	1 35 @ 1 75
Harness, (black)	3 00 @ 4 50
Shellac, Spirits	3 00 @ 3 50

LIME—PER BARREL.

State, common	— 90 @ — —
" finishing	1 15 @ — —
Rockland, common cargo rate	1 00 @ — —
" finishing	1 20 @ — —
Ground	1 00 @ — —

Add 25 cents to above figures for yard rates.

HAIR.

Cattle, ₱ bushel of 7 ℔s	— 16 @ — 18
Goat " "	— 25 @ — 28

SLATE.

Purple, roofing slate, ₱ square	$6 00 @ 7 00
Green Slate	6 00 @ 7 00
Red Slate	13 00 @ — —
Black Slate, Pennsylvania, (at Jersey City)	4 75 @ 5 25
Slate tiles, 1¼-inch, rubbed, ₱ square foot	— 20 @ — 25

PLASTER PARIS.

Duty.—20 ₱ cent ad. val. on calcined ; lump free.

Calcined, ordinary city, ₱ bbl	1 35 @ 1 45
Calcined, city casting	1 50 @ 1 65
Calcined, city superfine	1 70 @ 1 75

MAHOGANY.

St. Domingo, crotches, ordinary to good, ₱ ft	— 15 @ —28
St. Domingo, crotches, fine	— 20 @ —30
St. Domingo, logs, small	— 5 @ —38
St. Domingo, logs, large	— 12 @ —15
Frontera, Mexican, large	— 12 @ —15
Frontera, Mexican, small	— 6 @ — 8
Other Mexican	— 6 @ —12½
Honduras	— 6 @ —12½

ROSEWOOD.

Rio Janeiro, ordinary to good, ₱ ℔	— 2½ @ — 4½
Rio Janeiro, good to fine	— 5 @ — 8
Honduras	— 6 @ — 12½
Satin Wood, ₱ foot	— 15 @ — 75
Tulipwood, ₱ ℔	— 6 @ — 7
Lignumvitæ, large, ₱ ton	30 00 @ 50 00
Lignumvitæ, other sizes	10 00 @ 25 00

CEDAR.

Cuba and Mexican, small, ₱ super. ft	6 @ — 7½
Cuba and Mexican, medium	8 @ — 9½
Cuba and Mexican, large	10 @ —11
Florida, ₱ cubic foot	40 @ —75

DEADENING AND ROOFING MATERIAL.

Mineral wood for Roofs and deadening, ₱ ℔	— 1¼ @ —1½

LABOR.

Ordinary, ₱ day	2 00 @ 2 50
Masons, do	3 50 @ 4 00
Plasterers, do	4 00 @ — —
Carpenters, do	4 00 @ — —
Plumbers, do	4 00 @ 4 50
Painters, do	3 00 @ 3 50
Stone-Cutters, do	3 00 @ 3 50

REVIEW OF THE MARKETS.—In the lumber market during the past month business has been extremely slow, though no one has appeared to be disappointed, as the entire trade have been compelled to admit the absence of vitalizing influences. There has been, in fact, really nothing new of a positive character since our last report, and the search after interesting information proves fruitless. Distribution has been made only upon the most imperative wants of the hour as felt by consumers, and with the pervading spirit of caution extending through the entire commercial and financial circle, lumber, in common with other commodities, must succomb to the process of liquidation until a base is reached where investment will be considered free from all danger.

In the brick market there has been a slight shading on cost, but the position at this writing is, on the whole, in very fair shape, and we hear few, if any, serious complaints. The shrinkage on cost has had a tendency to stir up demand, and work, in many instances stopped when material was high, has been resumed, and to such an extent, indeed, as to create a more general demand, as shown in the fact that the medium and ordinary grades have received about as much attention as the better qualities.

In the cement market business on foreign brands has been unsettled and the reports quite conflicting, but investigation leads to the impression of a dull business and weakening values on a portion of the stock, with a good distribution for anything really desirable at fairly steady rates. The situation seems to be simply this, repeated trials have commenced to satisfy masons and contractors that good Portland is about as cheap, and, in some instances, cheaper than domestic, and the regular consumptive call, therefore, opened the year with a liberal volume, and has since increased.

In the lime market there is nothing new so far as made public. Demand has been full enough to exhaust stock as it has come to hand, and former rates bid, but as yet no advance shown. Intimations of an addition to cost, however, are given, and some of the trade think the change not distant.

In the lath market business has been dull, due to the absence of stock. Buyers have been on the lookout, and when offerings have been made, quickly took them out of the way. We understand that from out-of-town sources the demand has fallen off, but this is neutralized by an increase on local acount, and quite a little supply could be placed if available. There is some doubt as to exact selling basis at the moment, but our information leads to the impression that $2.10 would be the inside figure on anything desirable.

In the hardware market business has been irregular and by no means satisfactory to the majority of the trade. All reports given publicity do not admit the above condition of affairs, but the attempts to give the market a better showing than it is really entitled to, fails to stimulate buyers. Tools and builders' hardware continue the most salable goods on the general run of orders, but, in common with everything else, are taken only to the extent of immediate wants.

In the metal markets the demand for American pig has been fairly active, while Scotch pig has been quiet, with a moderate business doing. Manufactured iron has been active and prices firm. Pig tin has been quiet, with prices well sustained, while for tin plates there has been a fair demand at steady prices. In lead there has been but a small business doing. Zinc has been steady.

INSURANCE AGAINST MACHINERY ACCIDENTS.—There is a company in Manchester, England, that insures engines against accidental breakdowns. The object of the company is to reduce breakdowns to a minimum, and their periodical investigations, by indicator diagrams, often lead to the discovery of unsuspected defects. A report, recently made, shows that, of the breakdowns of the insured engines, forty-nine per cent. were due to accidental causes, fourteen per cent to the negligence of attendants, twenty per cent. to old flaws and defects, and fourteen per cent. to weakness or faulty construction.

Curiosity.

Probably no feeling has been held up to greater reprobation than that of curiosity. Early tradition is full of allusions to it. The fate of "Biue Beard's wife," and the third Calender in the "Arabian Nights," who has cause to lament the indiscreet anxiety which cost him his right eye, are familiar to us from childhood. "Peeping Tom's" fate is another legendary warning. "Paul Pry" is held up as an example to be shunned. Ancient mythology has its tales of Cupid and Psyche, of Cephalus and Procris. The Norse legends tell of the fate of the woman who rashly disturbed the grave of a hero to obtain his sword, and was consumed by the flames that surrounded the enchanted blade. History and real life add their tales of warning against too great a desire to know "the wherefore of every why." And yet the world would be badly off if no inquisitive people existed in it. Great inventors and discoverers are all, in one sense, full of curiosity. The desire for knowledge which Johnson averred to be common to every human being "who is not depraved," is a form of inquisitiveness. Columbus was intensely curious regarding the unknown world which he believed lay across the unexplored ocean. Curiosity has sent out a long succession of travellers into strange countries; from Marco Polo and Mandeville down to the latest African explorers. Curiosity has given the world scientific discoveries and valuable inventions. Curiosity regarding the life of previous ages has rescued interesting documents and ancient records from oblivion. Apples had fallen for thousands of years, kettles had babbled for centuries, but it was only when inquiring minds like Sir Isaac Newton's, and the Marquis of Worcester's and Watt's observed them that the principle of gravitation was discovered or the power of steam understood. Socrates was not so mistaken when he taught his disciples to ask questions, aggravating as the habit must sometimes have been to their fellow-citizens.

Without a certain amount of curiosity nothing would ever be learned. It was the sight of a book of mathematical diagrams that gave Pascal his first desire to study geometry; the strange figures awoke the boy's curiosity, and he became anxious to understand what they represented. Many a similar tale might be related of other geniuses. Curiosity of this description becomes enthusiasm. No difficulty or danger will deter the votary of art or science from attempting to solve the mysteries of his calling. Many a physician has, like Guyon, of Marseilles, given his life to gain an insight into the dark secrets of disease. Nearly every scientific discovery has been bought, at some period, by a life, worn away by over-study, or more directly sacrificed through accident or experiment. Deadly climates and unknown perils do not check the ardor of the explorer. Vandervelde, the celebrated sea painter being in a vessel during a raging storm, caused himself to be tied to a mast that he might study the effects of sea and sky, and kept exclaming. "Marvellous, sublime," totally oblivious of his danger. Leibnitz's royal patroness is said to have expressed herself as resigned to death, because she would then learn the answer to many questions Leibnitz could never be reply to—which is certainly pushing the love of inquiry to its extremest verge.

Forcing the Intellect of Children.—The *Medical and Surgical Reporter* in a recent able editorial on this subject, contends that much injury is done by sending children to school too early, and holds, very properly, we think, that the portion of life prior to puberty should be devoted mainly to physical development.

An Improvement in Water-Closets.

The requirements of proper sanitation in the dwelling house demand that the indispensable water-closet shall possess certain qualities which are rarely found combined and fully realized in a single apparatus. In recording the progress of the arts from month to month, it is our pleasant task to publish many and substantial improvements, but none afford us such real satisfaction as those which relate to the sanitation of the household, in which we are assured every one of our readers has a real personal interest.

The great desideratum in sanitary fixtures has been

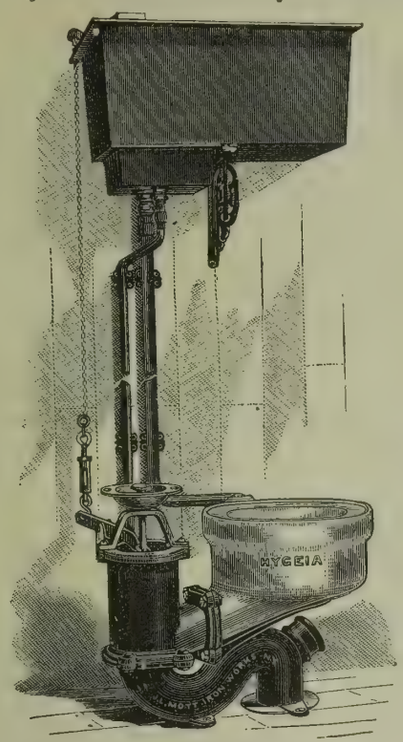


Fig. 1.—The "Hygeia" Closet, with Attachments.

a water-closet which would combine in convenient practical form the qualities of simplicity, durability and cleanliness. On the score of simplicity, the requirements are, that there should be no complicated parts, such as valves, springs, etc.; durability should be assured by the absence of delicate machinery liable

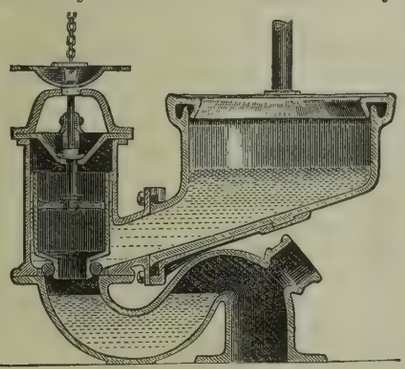


Fig. 2.—Sectional View of the "Hygeia" Closet.

to derangement in ordinary usage; and cleanliness, perhaps the most important of all, should be positively assured by the absence of any fouling spaces in which refuse matter can accumulate and putrify, and by providing effective means for thoroughly washing out the closet every time it may be used.

Where these three prime requisites of a theoretically perfect closet are sought to be combined in practice, and are really successfully combined in practical construction, we have as close an approximation to the ideal as it is possible to attain.

These qualifications are claimed to have been practically realized in the Demarest improved closet—the "Hygeia"—manufactured by the J. L. Mott Iron Works, of 88 and 90 Beekman street, this city, widely known for the variety and excellence of their sanitary appliances. We append herewith a brief description of this latest form of improved closet, with illustrations, from which our readers may judge how completely it realizes the claims of its makers.

Referring to the cuts, Fig. 1 is a perspective view of the "Hygeia" with needful attachments, and Fig. 2 is a sectional view, from which the special peculiarities of construction will be understood. By consulting the sectional cut, the extreme simplicity of the construction will be at once apparent. The flushing rim supplied from the cistern by an inch and quarter pipe, insures a quick and thorough wash of all parts of the closet, and the space (about one-eighth of an inch) around the plunger for overflow is washed out with great force every time the closet is operated. The operation of the plunger and lever, though simple, is very ingenious, the cup-shaped or concave cover giving full stroke to the lever, and the pull-rod being attached near the middle of the plunger, allowing the top of the same to be raised to the top of the section, thereby overcoming difficulties which have heretofore stood in the way of having a first-class cistern closet on the side-outlet principle, which is so much preferred by nearly every one, for fine work, as it shows no outlet, only the clean white porcelain bowl filled with pure water; it also does away with all cranks, axles, and other parts liable to wear out. Another very important feature in this closet, in view of the necessity of economizing our water supply, is the small quantity of water required for it—not over one gallon and a quarter being used each time it is operated, and this giving a wash equaled by none. The workmanship of this closet is of the best, nothing being spared to make it a superior article in every respect, which, taken in connection with its moderate price, cannot fail to strongly recommend it to public favor.

The manufacturers will be pleased to supply any additional facts respecting this excellent sanitary device that we, for want of space, may have omitted to mention.

Water Coolers.

Our attention has been called to a numerous assortment of water coolers of various styles, sizes and wide range of prices, with or without stands, to suit the various requirements of the household and business office, which are manufactured by F. T. Witte, of 111 Chambers street, this city. The impending warm season makes a reference to these indispensable adjuncts to health and comfort very appropriate, and the coolers above referred to are in all respects excellently adapted to their intended purpose, being tasteful in appearance, constructed of the best materials, and natural in design. The selection of a water cooler should be made the subject of personal attention by every intelligent householder who is at all sensitive on the subject of cleanliness and the proper sanitary regulation of his household, for if not properly constructed and intelligently cared for, it is quite as likely as not to become a source of danger to the health of those who use it. Those of our readers who may care to pay a visit to Mr. Witte's establishment, will find no dearth of stock to select from, and may take the assurance, founded upon our own experience, that his goods are in every respect excellent

Cleaning Brass.—The Government method prescribed for cleaning brass, and in use at all the United States arsenals, is claimed to be the best in the world. The plan is to make a mixture of one part common nitric acid and one-half part sulphuric acid in a stone jar, having also ready a pail of fresh water and a box of sawdust. The articles to be treated are dipped into the acid, then removed into the water, and finally rubbed with sawdust. This immediately changes them to a brilliant color. If the brass has become greasy, it is first dipped in a strong solution of potash and soda in warm water; this cuts the grease, so that the acid has free power to act.

Planting a Forest.

From "Methods and Profit of Tree-Planting," by N. H. Egleston, in the *Popular Science Monthly*, we take the following:

The first, the fundamental, point in tree-planting on a large scale—that is, in planting what may be called a forest, is to consider the trees as a crop, like any other crop, only this requires a much longer time than ordinary crops to come to maturity. This will at once put the subject to many, if not to most persons, in a new aspect. Accepting the idea that trees are to be planted like corn or wheat, as a crop, there follows at once the necessity of care and cultivation and the consideration that these are the conditions of success. We do not expect to harvest an ordinary crop, and one that will yield a satisfactory pecuniary return, without having bestowed upon it care and labor. No more should we look for success in the larger growths of the forest without a corresponding culture. And when we come to look upon the growth of a forest in this light, we shall easily, almost inevitably, regard our ordinary native forests, where the trees are simply suffered to grow up in complete neglect, exposed to injury from the intrusions of cattle and from other causes, as at best only a partial utilization of the fields which nature has provided for our comfort and profit. It is true that trees will grow and come to maturity in rough places and on poor soils, where nothing else will grow, or where the cultivation of other crops is impracticable and unprofitable. It is true, also, that the growth of great forest crops, instead of impoverishing, enriches the soil. Hence there is no use of our poor and what we call waste lands, which abound more or less everywhere, at once so economical and profitable as to devote them to the growth of trees. Left to themselves, as our forests and woodlands generally are, they are remunerative. But they might be made much more remunerative. They would be, if, instead of regarding them as one of the accidental products of nature, we were to regard them as one of our staple crops—something to be managed and cared for by us.

Avery's Anti-Friction Bearing.

The most effective method of reducing the friction of journals, etc., to a minimum, is, by general consent of mechanics, admitted to be by providing a revolving bearing of hardened steel rolls; and many devices embodying this idea have been produced, and introduced with more or less success in practice.

One of the simplest, best constructed and most effective of these, is the so-called anti-friction bearing, designed and manufactured by Mr. John G. Avery, of Spencer, Mass., and which is specially designed to be used with shafting, carriages and team wagons. The principle of Mr. Avery's device is substantially the same as that above named, but its special merits, which have been amply demonstrated by several years' of very successful use, reside in certain peculiarities of construction and of manufacture, which are exclusively his own.

These will be comprehended from the following general references: The journal is of hardened steel, and revolves, as above remarked, upon a series of hardened steel rolls placed within a shell, and the whole enclosed and working in a box, which is also lined with hardened steel. The rolls are so disposed in the shell, that they form six or more rows or sets, according to circumstances, their arrangement being such that no two of the rolls are in the same line. The rolls, therefore, which are free to revolve form the bearing surface of the journal, and reduce the frictional resistance to a minimum.

This bearing has been successfully applied to shafting, heavy team wagons, road wagons, expressmen's trucks, paper-mill rag engines, circular saw arbors, miner's drilling machines, bicycles, etc. The maker claims that his device performs its intended function so perfectly that the use of lubricants may be dispensed with, and that a hot box where this bearing is in use is impossible. Finally, this invention is represented to have had a long and most thorough test for shafting, carriages and team wagons, for which it has been found to give the utmost satisfaction. The maker represents the success of this device to be due to the special construction of the shell which holds the rolls and keeps them in place, and to the properly hardened surfaces—the rolls, journal and box all requiring to be hardened. The maker further adds that he has devised special machinery for constructing this device economically, and a special process for hardening, and claims that there is no instance in which a rotary motion is desired, but that, by the use of these bearings, at least one-third of the power can be saved.

The New England Manufacturers' and Mechanics' Institute Fair.

While it is yet scarcely time to devote much space to the topic of the fall fairs which are being arranged for by various societies and institutions throughout the country, it will be of interest to many of our readers who had the good fortune to visit Boston last autumn, when two great, and in many particulars representative, fairs were in progress, almost side by side, to learn that the young and vigorous institution that signalized the first year of its corporate existence by holding so fine and creditable an exhibition (we refer to the New England Manufacturers' and Mechanics' Institute), is proposing to far outshine its last year's record, by the fair which it is proposing to hold during the coming autumn.

The fair of this year will be general in character, like that of the previous year, but the effort is being seriously made to have it considerably larger in the extent and variety of its display. This object the energetic managers have no doubt of being able to accomplish. They have shown their faith by their works, having, on the assurance that "there is nothing so successful as success," and encouraged by the remarkable results obtained in their first experience, made very considerable improvements and enlargements both to the interior and exterior of their buildings and grounds, to increase their accommodations and facilitate access to and from their exhibition. With the prestige of so creditable a beginning, and with so much energy, there can be but one result, and we venture to predict for the coming exhibition a magnificent success, and anticipate much pleasure and profit in paying it an extended visit.

As we stated in a previous notice, the exhibition will open Wednesday, September 6th, and continue until November 1st. The reception of goods will commence on August 1st. We shall keep our readers posted from time to time respecting the arrangements of the exhibition as they are made public.

Miscellaneous and Advertising.

Scholz's liquid blacking consists of 50 parts asphalt, 50 parts naphtha, 6 parts linseed-oil varnish, 14 parts train oil, and 13 parts of spirits of wine.

The Curtis Regulator Co., of 54 Beverly street, Boston, has recently received an order from the Lockwood Co. for three sets of their pressure regulators and steam traps for the new mill at Waterville, Ill.

The George Place Machinery Agency, of 121 Chambers street, this city, have always on hand a large line of new and second-hand machinery of every description.

The Westinghouse Machine Company, whose office in this city is at 92 and 94 Liberty street, are turning out their engines at the rate of nearly two per day, and within two months they expect to build four per day.

"How to Keep Boilers Clean," and other valuable information for steam users and engineers. Book published by James F. Hotchkiss, 84 John street, New York. Mailed free to any address. (Mention this paper.)

C. D. Wainwright, of 73 Kilby street, Boston, Mass., reports, among the large number of orders recently filled for Strong's patent feed-water heater and filter, the following: Carnegie Bros. & Co., Pittsburgh, Pa., two 1,000 horse-power each; the Iron and Steel Association of Virginia (Limited), two 400 horse-power each; the Union Iron and Steel Co., Chicago, Ill., one 800 horse-power; the Sombrerete Mining Co., of Mexico, two 400 horse-power each; S. B. Perkins, Cleveland, O., one 250 horse-power; Corrioeau & Co., (silk mills), Montreal, Canada, one 100 horse-power; the Asphalt Block Manufacturing Co., 19th and Lincoln streets, Chicago, and one in Young & Farrel's diamond stone-sawing establishment on West 12th street.

Shall I Export?

TO THE EDITOR OF THE MANUFACTURER AND BUILDER:

This question is puzzling the minds of many manufacturers, while others are up and doing, reaping good harvests. There is no question but there are many lines of business which can profitably reach over into other lands and create a demand there as well as here, by judiciously advertising any certain brand or line of goods.

People in other countries are as susceptible of being approached and made to think that what is seen in the newspaper, "must be so because their local paper had it in," as any in this country. A neat pamphlet on this subject has been recently published by me, and I will take pleasure in mailing it to any who are sufficiently interested to send their address.

H. P. HUBBARD, *New Haven, Ct.*

Design for Cottage, Costing $1,200.

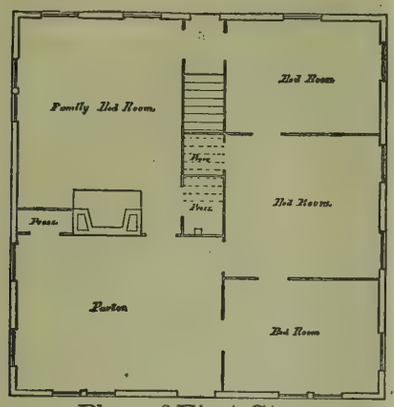
The cottage shown on the opposite page was built near the little village of Orangeburgh, S. C., for Dr. DuBois, of Hudson, N. Y. As will be seen by the plans, it is arranged for a small family only. The kitchen and apartments for servants are in another building, tastely arranged and close at hand—a custom peculiar to the Southern States. As the house is occupied but about two months during the winter, it has not the completeness that characterizes the owner's house on the Hudson. The large fire-place in the parlor for burning wood, is a positive requirement in that latitude.

The piazza, 10 feet wide, which extends around the entire building, is not shown on the floor plans. The manner of carrying it the full hight of the main building in the gables gives a fine effect, while breaking the eaves takes away the monotony of what would otherwise be a disagreeable roof.

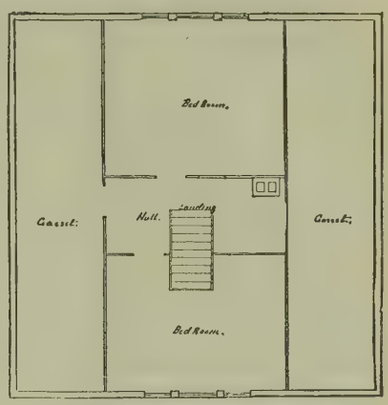
The house stands well up from the ground on posts, which are hidden by the open-work under the piazza. The frame is of thorough balloon construction, and is finished inside with Southern pine, except the trimmings. The roof is of shingles, and painted.

It is doubtful if a more commodious, comfortable or pretty cottage could be built, at the same cost, than this would be when handsomely painted in colors, hightened with occasional vermilion chamfers, etc., the roof also coming in for a reasonable amount of ornamentation. The cost was $1,200. The arrangement of the interior can be readily modified to suit the wants of our latitude.

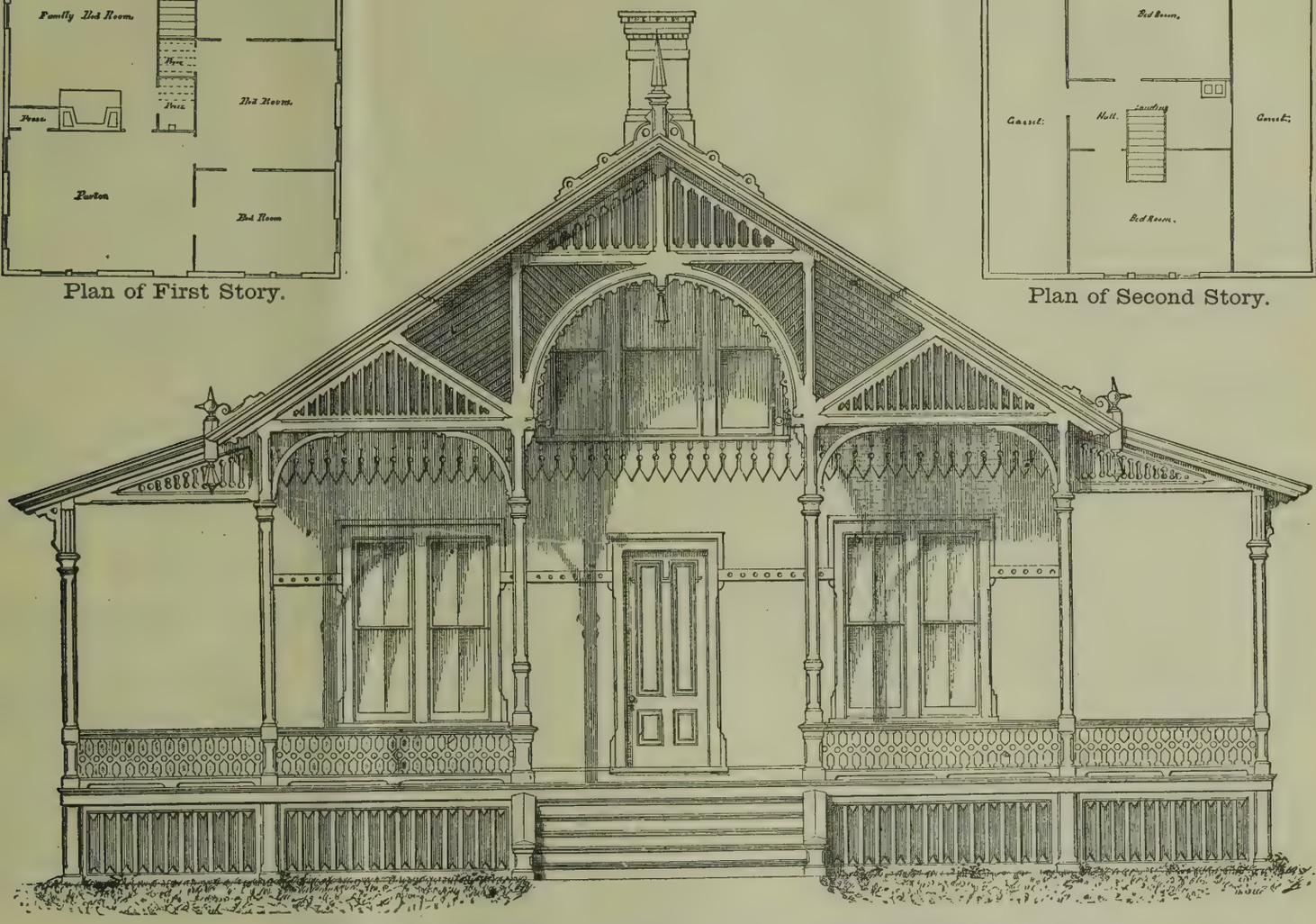
The design is by J. A. Wood, architect, of 240 Broadway, New York, who is now, among other work, completing at Poughkeepsie, for Mr. Allen, proprietor of the Astor House, the most ornamental and beautiful cottage on the banks of the Hudson. Some idea of the ornamentation may be arrived at from the number of colors and shades employed in decorating the exterior, which is upwards of a dozen and a half. The effect is perfect, and nothing like it has ever before been attempted.



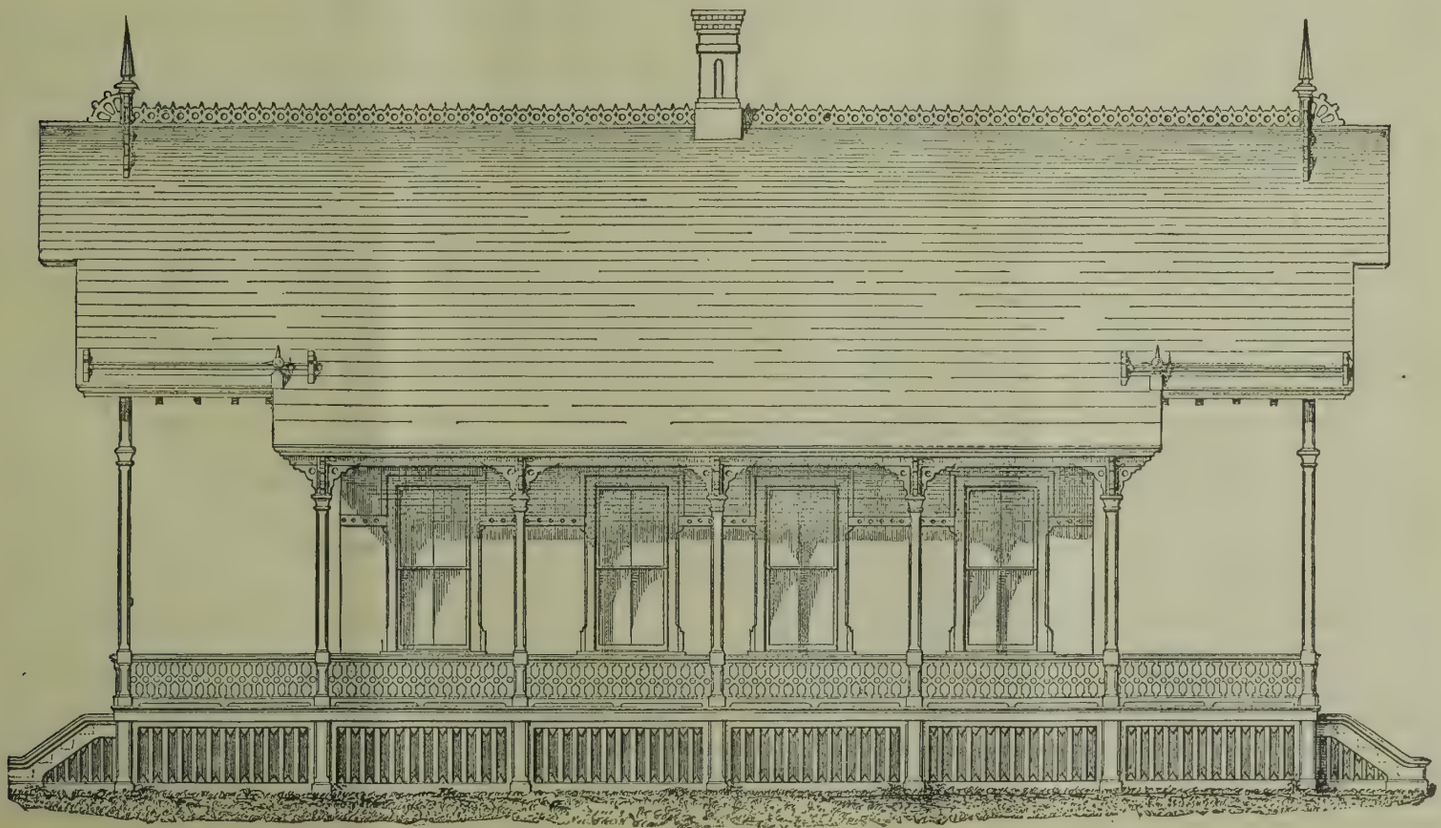
Plan of First Story.



Plan of Second Story.



DESIGN FOR COTTAGE, COSTING $1,200---FRONT ELEVATION.



SIDE ELEVATION.

Why the Prairies are Treeless.

Mr. L. F. Ward gives in the *Kansas City Review* some reasons why the Western plains are destitute of forests. Where the annual rainfall exceeds 24 inches, the absence of forests is undoubtedly due to the repeated burnings which take place on the prairies from human agency. Where the annual rainfall is below 20, or perhaps 24, inches, there can be no growth of forests, and this is the true cause of the absence of trees on the great plains. But this does not prevent the existence in arid regions of certain specialized types of arborescent vegetation. The sage brush that covers the dreary wastes of the Rocky Mountain region, the Laramie plains, the Bitter Creek valley, and such vast areas of the West, while in its botanical character it is little more than an overgrown weed, is to all intents and purposes a tree, and often attains a great age. The region it occupies is even more arid than the great plains, yet no fires occur and no forests grow. In the nearly rainless areas of Arizona, Southern Utah and New Mexico, and stretching eastward into Texas, there occur a number of arborescent forms—the creosote bush (Larrea Mexicana), the mesquit (Prosopis juliflora), various acacias and mimosas, and one yucca (Y. brevifolia), together with the tree cactus (Cereus giganteus). These grow scattered at great distances from each other, and rarely form thickets or groves. Why no such characteristic species are found occupying the great plains, is not known, and it is probably a mere accident that none happen to exist, adapted both to their temperatures and their arid condition. Did any such exist, there seems no reason why they might not thrive as well as the sage brush further west or the mesquit of the South.

Useful Hints to Steam Users.

The element of cost is one which appeals most directly to the interest of every user of power, and in this connection no question is of as much importance to the steam user as that of economy in the consumption of coal. Those who have given serious thought to the subject, will doubtless agree with us that while the largest share of attention has always been directed to the improvement of the engine through which the steam is consumed, but a trifling part of that which it deserves has been devoted to the perfection of the steam boiler in which the steam is generated. There is no doubt that the attention of expert mechanical engineers will shortly be diverted into this channel, and with important results, for though much has been accomplished that a few years ago would have been pronounced impossible, in increasing the duty of steam generators, and their safety against disastrous explosion, something remains to be done to bring the results of practice into conformity with that which theory pronounces to be possible.

One decided step forward in the direction of securing greater economy in the use of fuel for steam generation, and in effecting greater safety for life and property against destructive explosion, was accomplished by the very notable and important development and perfection of the sectional system of constructing steam generators, which has to-day its most successful exponent in the sectional boilers manufactured by the Babcock & Wilcox Co., of this city. So decided, indeed, has been the change of opinion in the mechanical world of late years in favor of the "water tube" as compared with the "fire tube" system of boiler construction, that we may reasonably expect that whatever improvements are made in the future in the direction of economy in the generation of steam, will be in the direction of perfecting this system of constructing steam generators. This inference is strengthened by the now generally admitted fact of the vastly greater safety of boilers constructed upon this system.

How serious the danger from steam boiler explosions really is, is not known even to the expert in such matters, for it does not appear save under the dry and uninteresting disguise of tables and statistics of municipal inspectors and steam boiler inspection companies. To give substantial basis to the assertion, we append some facts from a late report of the Hartford Steam Boiler Inspection and Insurance Co., which are instructive. The company in question report that up to January 1, 1881, they had made in all 331,218 inspections, and had discovered 163,065 defects, of which 36,627 were considered dangerous. If, now, the above were a fair average of the boilers in ordinary use—and who shall say they are not?—we have the startling fact that about one boiler in nine, in common use, is in a dangerous condition. That more do not explode, is probably due less to intelligent supervision than to the fortunate lack of all necessary conditions existing at one time.

Concerning the efficiency of the sectional system of boiler construction to secure immunity from dangerous explosions, there is but one opinion among experienced engineers. Those of our readers, however, who may be doubtful on the subject, are referred for several remarkable examples demonstrating the advantages of this class of boilers in this particular, to the cases reported in this journal for February, 1880, the accuracy of which is vouched for upon unimpeachable authority.

From a valuable pamphlet compiled by the Babcock & Wilcox Company, which contains besides an able defence of their system of boiler construction, which concurrent opinion of well-informed engineers has rendered quite unnecessary, we add some interesting facts and figures bearing upon topics of interest to the steam user. The following table of American coals has been compiled from various sources:

COAL. STATE.	KIND OF COAL.	Per cent of Ash.	Theoretical value in Heat Units.	Theoretical value in Pounds of water evap'd.
Pennsylvania	Anthracite	3.49	14,199	14.70
"	"	6.13	13,535	14.01
"	"	2.90	14,221	14.72
"	Cannel	15.02	13,143	13.60
"	Connellsville	6.50	13,368	13.84
"	Semi-bituminous	10.77	13,155	13.62
"	Stone's Gas	5.00	14,021	14.51
"	Youghiogheny	5.60	14,265	14.76
"	Brown	9.50	12,324	12.75
Kentucky	Caking	2.75	14,391	14.89
"	Cannel	2.00	15,198	16.76
"	"	14.80	13,360	13.84
"	Lignite	7.00	9,326	9.65
Illinois	Bureau county	5.20	13,025	13.48
"	Mercer county	5.60	13,123	13.58
"	Montauk	5.50	12,659	13.10
Indiana	Block	2.50	13,588	14.38
"	Caking	5.66	14,146	14.64
"	Cannel	6.00	13,097	13.56
Maryland	Cumberland	13.98	12,226	12.65
Arkansas	Lignite	5.00	9,215	9.54
Colorado	"	9.25	13,562	14.04
"	"	4.50	13,866	14.35
Texas	"	4.50	12,962	13.41
Washington Territory	"	3.40	11,551	11.96
Pennsylvania	Petroleum	....	20,746	21.47

"Slack" or screenings from coal, when properly mixed—anthracite and bituminous—and burned by means of a blower on a grate adapted to it, is nearly equal in value of combustible to coal, but its percentage of refuse is greater. A number of firms are using slack with decided economy under Babcock & Wilcox's boilers, in which there is ample space below the tubes for the dust to accumulate, without covering the heating surface or impairing the draft.

New Publications.

Thieves of Homes; or, Habits that Impoverish. By Rev. J. M. Anspach, Pastor of Christ Lutheran Church, Easton, Pa. Easton: Chas. A. Hilburn. 1881. (For sale at the Philadelphia Lutheran Publication House, 42 North Ninth street, and at the Lutheran Book Store, 117 North Sixth street). Price $1.

The above work contains the substance of a series of lectures giving much wholesome and excellent advice, and inculcating the virtues of temperance, frugality, economy, industry and earnestness of purpose. Some of his thieves of home are alcohol, tobacco, bad books, promiscuous amusements, the gaming table, extravagance in dress and diet, wastefulness and mismanagement, penuriousness and indolence. His pen pictures of the misery and unhappiness that follow in the wake of these, and other habits that impoverish, are vivid and truthful; and the moral lessons he seeks to teach are saved from becoming the wearisome platitudes they often become in the hands of gentlemen of his cloth, by a strain of thorough earnestness and a homely simplicity of thought and speech that attract.

We could have wished that the reverend author had not been so pronounced in his denunciation of many forms of amusement, for which he manifests all the old-fashioned orthodox aversion; but there is so much that is good and wholesome and helpful in the book, that we would be unjust to the author to allow an excess of zeal that has impaired the clearness of his judgment in one case, to outweigh so much that is worthy of praise.

Grimshaw on Sawing Machinery. Messrs. John Wiley & Sons announce as in preparation a valuable practical illustrated work on American and European sawing machinery, by R. Grimshaw, whose previous work on saws is now going through a second and greatly enlarged edition.

The work on sawing machinery will be a large cloth-bound quarto, with over 200 cuts. The table of contents embraces the history, classification, comparison and construction of sawing machinery; descriptions of various machines, with dimensions, speeds, capacities and power required; various sawing operations, as felling, butting, slabbing, squaring, ripping, cross-cutting and edging; lath, shingle and picket making; grooving, tenoning and scroll sawing; desiderata in sawing machinery, instructions for ordering, cautions in buying, site of saw mills, plan and construction of buildings, generation and transmission of power, kerf waste, tables of log measurements, lumber grading and gauges; United States patents on sawing machinery from 1790 to 1882; hauling, dogging and crossing the logs; insurance of saw mills; cremating sawdust and slabs; distribution of the timber supply in the United States, Canada and Europe; characteristics of various American and foreign woods, etc. Such a work would prove highly useful to sawyers, cabinet-makers, builders, and nearly all wood-workers and proprietors of mills. The subscription price is $10.

Alcohol and Science; or, Alcohol, What it is and What it Does. By Wm. Hargreaves, M.D. New York: National Temperance Society and Publication House. 1882. 12mo, 366 pp. Price $1.50.

The above work was adjudged, by a special committee appointed by the Seventh National Temperance Convention at Saratoga, N. Y., to endeavor to secure an American standard work on temperance, to be satisfactory, and was awarded a prize of $500, which had been offered for the best essay "presenting the status of the temperance question and argument in the present light of science."

Those who are interested in the subject will find in this work a forcible presentation of the alcohol controversy from a scientific standpoint. The author's conclusions are sweeping and radical. He holds that "alcohol is a poison, and not a food in any sense; for, instead of nourishing, it poisons; instead of strengthening, it weakens; instead of stimulating, it narcotizes and paralyses; instead of increasing the vital forces, it diminishes force; and is an agent of degeneration and death."

Marriage and Parentage, and the Sanitary and Physiological Laws for the Production of Children of Finer Health and Greater Ability. By a Physician and Sanitarian. New York: M. L. Holbrook & Co. 1882.

The author of this volume has essayed a delicate task, but he has accomplished it with proper regard for the proprieties; and while his work contains much that is valuable and sensible, there is nothing in it that could be objected to by the most fastidious. The book is an earnest and sensible appeal for establishing the relations of the sexes upon a basis more in accord with sanitary and physiological laws than they now exist. The author steers clear of the rock upon which some notable radicals have made shipwreck in their treatment of the subject, in that he holds the marriage relation sacred, only seeking to improve it. The book may be read with profit.

OTHER PUBLICATIONS RECEIVED.

Statuten des Deutschen Technischen Vereins von Philadelphia. 1882. From the Society.

Silk Culture in the United States. By Lorin Blodget. Reprint from the *Journal of the Franklin Institute.* From the author.

Jahresbericht des Technischen Vereins von New York, für das Vereinsjahr 1880-81. From Dr. Bruno Terne, Philadelphia.

The Death-Rate of Memphis. By George E. Waring, Jr., Newport, R. I. Reprinted from the *American Architect* of March 25th, 1882.

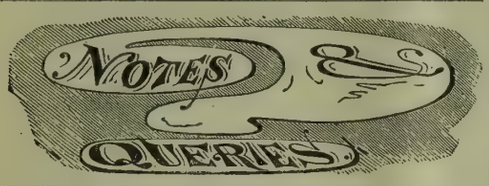
Statement Relative to the Artificial Coloring of Imported Sugars, prepared by Dr. Gideon E. Moore. Washington: Government Print. 1881. From the Secretary of the Treasury.

Quarterly Report of the Chief of the Bureau of Statistics, Treasury Department, Relative to the Imports, Exports, Immigration and Navigation of the United States for the three months ended December 31, 1881; also containing other Statistics relative to the Trade and Industry of the Country. Washington: Government Printing office. 1882.

Summary Statement of the Imports and Exports of the United States for the month ended March 31, 1882, and for the nine months ended the same, compared with the corresponding periods of 1881. Prepared and published by the

United States Bureau of Statistics. [Corrected to May 8, 1882].

State Board of Health of New York. Report to the State Board of Health on the Methods of Sewerage for Cities and Large Villages in the State of New York. By James T. Gardiner. Albany: Weed, Parsons & Company. 1882. From the Board.



This department is intended to furnish, for the benefit of all our readers, information on any subject of a scientific or technical character falling within the field of THE MANUFACTURER AND BUILDER. *Any of our readers possessing additional or more correct information than that which we give relating to the questions, are cordially invited to communicate it to us for publication. We also request that all questions or answers be written on separate pieces of paper, and addressed to the Editor.*

QUESTIONS.

(3008) THE CASSAVA.—I read some time ago an account of glucose being made from cassava, and the statement was made that it gave a much larger yield than corn, and of better quality. Is the cassava a native of the United States?—J. S., Waterloo, Iowa.

(3009) STEREOTYPING.—I would be obliged if you would be able to find space for a description of the mode in which stereotypes are made.—L. L. E., Bellefonte, Pa.

(3010) AMBERGRIS.—Is it known how ambergris is formed? and if so, will you tell what is known about it?—D. M., Galveston, Tex.

(3011) WATER-PROOF GLUE.—I want a receipt for a strong water-proof glue, and will be very much obliged if you can give me one that will answer my purpose.—J. H. W., Atlantic City, N. J.

(3012) GILDING LEATHER.—Will you please give me some instruction as to how to gild leather.—C. J., Washington, D. C.

(3013) SILVERING GLASS GLOBES.—Can you tell me in your department of Notes and Queries, how glass globes, used for ornaments, are silvered?—C. J., Washington, D. C.

(3014) GILDING ON WOOD.—Please give me directions for gilding on wood, and oblige.—C. J., Washington, D. C.

(3015) RUBBER-STAMP INK.—Can you give me a formula to make a good rubber-stamp ink?—J. G., Altoona, Pa.

(3016) ACID IN MACHINE OILS.—Is there any simple and quick method of finding the presence of acid in machine oils?—W. B. L., Wilmington, Del.

(3017) SUBSTITUTE FOR SAL-AMMONIAC.—Will you please give me the name of an article used as a substitute for sal-ammoniac in galvanizing. I understand it is imported. It is of small grain and about the color of sawdust. It produces the same effect upon hot zinc as sal-ammoniac. Please oblige an old reader of your journal.—J. H. W., San Francisco, Cal.

(3018) STAINING THE SKIN.—Can you inform me through the columns of your valuable paper if there is anything artificial that will give a person's face a tanned or sun-burnt appearance? I have heard that the Indians use something of the kind to disguise white men who join their bands, by staining them brown. I am afflicted with a ghastly paleness of face, which is the remark of every one I meet, and is extremely annoying. When I have been under a hot sun for three or four days, and become thoroughly tanned, I look all right. I might say that I enjoy good health. You may think this a very strange question to ask you, but it is of great moment to me, and I have seen some very strange queries in your journal, and saw them answered too.—G. E. H., London, Ont., Canada.

(3019) GELATINE MOLDS.—Can I obtain gelatine, ready for use, such as is used for making molds for plaster casts? Is there any book that treats upon the subject of making molds? Is Cameron's Plasterer's Manual in print?—J. F. S., La Grange, Ind.

(3020) COFFEE CULTIVATION IN THE UNITED STATES.—Is coffee cultivated in the United States? If so, where, and to what extent?—H. D., Tallahassee, Fla.

(3021) PUBLIC LIBRARIES.—Where can I procure list of the public, college and other important libraries of the United States?—V. McW., Austin, Tex.

(3022) EFFECT OF SUNSHINE ON A FIRE.—There is a popular belief very general among housewives and domestics, that if the sun is left to shine directly on a fire it will go out. I would ask you if there is any truth in this?—R. S., Boston, Mass.

(3023) TRANSPARENT COLORED VARNISHES.—I have tried to make some transparent colored varnishes, such as are used to decorate fancy metallic boxes and cases. Can you aid me with any suggestions?—H. D., Trenton, N. J.

(3024) INDELIBLE INK.—A correspondent wishes to know why it is that those portions of his collars and cuffs which are marked with so-called "indelible ink," are eaten out in the laundry. This does not occur with his "home washing." The same inquirer would like to find out some ink that will stand laundry washing. "Payson's" will stand home washing for years, but the laundry takes it out in three washings. He gets best results from draftsman's India ink.

(3025) PORTABLE HOUSES.—Would you be kind enough to inform me if there is in the United States a firm of builders that makes a specialty of constructing small portable houses, say of one or two rooms. I would like to obtain one with material easy to transport, and use it as a substitute for a tent during the summer.—H. M., Roxbury, Mass.

(3026) SPRUCE BEER.—I drank a very pleasant summer beverage at a farm-house some time ago, called "spruce beer." Can you tell me how it is made?—C. C., Brooklyn, N. Y.

(3027) GRISCOM'S ELECTRIC MOTOR.—An article was copied from your journal by the *Scientific Canadian*, respecting Griscom's electric motor, which interested me so much I am very anxious to get more information. I have tried in several directions to obtain the address of the parties owning the patent, or even the address of the inventor, but have failed. Will you kindly give me any such addresses, or at least put me in the way of finding out.—R. R. Y., Toronto, Ont., Canada.

REPLIES.

(3008) THE CASSAVA.—The cassava, or, properly speaking, manioc, is, we believe, a native of South and Central America, but flourishes in Florida, though whether indigenous or imported into that State we have at the time of writing no means of determining. The statement that cassava yields a larger percentage of glucose than corn, is very probable, since it contains, weight for weight, a much larger percentage of starch than the latter. The following information respecting the plant may be of interest to this inquirer, as it covers the ground of his questions quite fully: A bushel of corn weighing 56 pounds will yield 30 pounds of glucose. The manufactured glucose is used chiefly for making table syrups, candies, for brewing purposes, as food for bees, and making artificial honey. It is estimated that 11,000,000 bushels of corn will be used this year by the various manufactories of this product in this country. The average production of corn in the States of Pennsylvania, New York, Ohio, Michigan and Illinois is 35 bushels to the acre. The amount of glucose produced from one bushel is 30 pounds, or 1,050 pounds to the acre. Well authenticated evidence is at hand to the effect that 20 tons of cassava to the acre is no unusual crop in Florida. This would, at 56 pounds to the bushel, give a yield of over 700 bushels per acre, and, at the rate of 30 pounds of glucose per bushel, would produce over 21,000 pounds of glucose per acre. A comparison of the yield of glucose from corn and cassava from a large area is as follows: 1,000 acres of corn yield about 500 tons of glucose; 1,000 acres of cassava yield about 10,000 tons of glucose. The method of cultivation is generally as follows: The ground is prepared as for planting corn, the seed (which consists of a section of the stalk containing an eye) is set in the sandy soil, spaced about 2 feet, in rows about 3 feet apart. When about 18 inches high, the field is cultivated in order to raise the soil about the base of the stalk, which affords a better support to the plant. The leaves of the branching top shade the ground, and prevent the formation of weeds and evaporation of surface moisture. No irrigation is required, as the moisture is continually supplied to the tubers by capillary attraction. The tubers grow somewhat similar to the sweet potato, radiating from the base of the plant, and lying generally horizontal. They may be utilized in about six months after planting, and will continue to grow without deterioration for a period of two years and upwards, developing to such an extent that tubers weighing from 60 to 80 pounds have frequently been taken from the soil. The harvesting of the crop is very simple. The stalk is raised, and the tubers extracted by simply pulling them from the loose soil. The plant may be again inserted, when it will produce new roots. The earth in this case is the storehouse from which the supply is extracted, as required, with the advantage of the crop increasing in value as long as it remains therein, whereas, in corn, there is a season for harvesting, storing, handling and rehandling before it comes to the hands of the manufacturer. Cassava may be removed from the ground any day in the 365, and carried to the mill for direct treatment. For many years the root has been raised in Florida, and used for many purposes. The plants are natives of South America. The roots (tubers) may be preserved for food purposes by being simply cleaned, sliced and dried; from such dried slices, manioc or cassava meal, used for cassava bread, etc., is prepared by simply grating. The starch is separated and prepared for food under the name of Brazilian arrow-root; and this, when agglomerated together into pellets on hot plates, forms the tapioca of commerce. The glucose made of cassava is of fine body and flavor.

(3009) STEREOTYPING.—The following is a brief description of the usual mode of stereotyping: We will suppose a form of type is to be copied. The clean type form is covered all over with a thin coating of olive or sperm oil applied with a brush. Another frame for the plaster is placed over it, and has four set-screws to enable the cast to be removed slowly from the type, and to regulate its thickness. The first cast of plaster of Paris is of fine, pure material, but the backing is usually made of plaster with which some finely sifted coal ashes have been mixed. It is customary also to add some common salt to the plaster to hasten its setting. The cast is removed when the plaster has set sufficiently, and is brought, while still damp, in contact with the molten type metal, in the manner to be presently described. The reason given for this is that the sudden drying gives a better impression than if the plaster is first dried in the air, or in an oven. Plaster expands in setting; if all the particles were of the same size, had been equally calcined, and had absorbed an equal amount of water, this expansion would be uniform. But in practice this is not the case. The particles of plaster are irregular in size, their degree of calcination is different, and the water is consequently unequally absorbed. As a consequence, those portions of the mass that have absorbed their quota of water and have set, are pushed from their position by the expansion of the plaster behind which has not already completed its hydration. Therefore, the impression which is accurate and sharp immediately after removing the cast, will become somewhat distorted if the hydration is allowed to complete itself slowly after the withdrawal of the mold. A sudden heating and drying will reduce this evil to a minimum. The sudden heating and drying of the cast by bringing it at once into contact with the molten stereotype metal is attended with some danger from cracking by the sudden expulsion of the contained water; but this is obviated largely by making the body of the cast very porous by the admixture of ashes, as above described. For obtaining the metal impression, the plaster cast is placed face downwards into a flat, rectangular cast-iron boat, swinging from a crane over the metallic bath, the temperature of which should be just sufficient to slightly brown a strip of white paper dipped into it. The sides of the boat are slanting. The distance from the plaster cast to the bottom of the boat, which gives the thickness of the metal plate, is regulated by metallic rules, and the plaster is prevented from raising by cross bars and pressure screws, or lugs on the inner face of the lid or cover of the boat, This last has the four corners removed, so as to leave openings for the introduction of the molten metal by means of a ladle. It is fastened in position by a clamp, attached to the rod of the crane, swung over the metal bath, and lowered until it rests on the surface of the molten metal. As soon as it heats up somewhat, the metal is slowly introduced into the boat through the orifices in the cover, before mentioned, and this is continued from time to time until the boat is full and all ebullition from escaping steam has ceased, when the boat and its contents have acquired the temperature of the bath. To insure the complete filling of the boat and perfect contact of metal on the face of the mold, the boat is generally submerged for a time beneath the surface of the metal. The boat is then raised, swung over a box containing damp sand, or on bricks or other support above a body of water, by which the boat cools off very rapidly. As the metal contracts, enough liquid metal is added from time to time to keep the boat filled and the casting fast against the plaster; and when it is sufficiently cooled off, the cover is removed, the plate of metal with the plaster adhering taken out, the plaster broken away, and the metal cast, or stereotype, is ready to be trimmed, dressed and mounted for printing. These operations are similar to those used with electrotype plates, the manipulation of which was described in a former issue, and need not therefore be repeated. The composition of the metal used in this operation is about 15 parts of antimony to 100 of lead.

(3010) AMBERGRIS.—Ambergris for a long time puzzled the *savants*, who were at a loss to account for its origin, and thought it at first to be of the same nature as yellow amber, whence its name of "gray amber" (from the French *ambre gris*). It is now ascertained beyond doubt to be generated by the spermaceti whale, and perhaps by other species, being probably a biliary calculus, or mass of undigested and biliary matters. The presence of this material in the animal is considered to be the result of some diseased condition. It is generally found floating on the surface of the sea, having been ejected from the stomach of the animal, or is picked up on the seashore. It is found in this way principally on the coasts of Greenland, Brazil, India, China, Japan, and formerly to a considerable extent on the west coast of Ireland. It occurs in masses of irregular shape, usually only a few ounces in weight; but concretions weighing 200 pounds and over have been found. Its general color is grayish-white, with bands of brown or black, as if marking the addition of layers. It has a waxy texture; pungent, agreeable odor, and fatty flavor. It is lighter than water, melts at 140° Fah., dissolves readily in absolute alcohol, ether, and in both fatty and essential oils. It contains 85 per cent of an aromatic substance called "ambreine," which may be extracted from it by digestion with alcohol of 0.827 specific gravity, filtering the solution, and leaving it to spontaneous evaporation. The ambreine then forms delicate white tufts, and is converted into ambreic acid by treatment with nitric acid. The material forms an important article of export from Morocco, where it is derived from whales cast up on the west coast. Madagascar likewise furnishes considerable. Ambergris is highly valued in perfumery, not so much for its own fragrance (for by itself it has an earthy or moldy flavor) as for the permanence it gives to com-

pounds into which it enters. Blended with other perfumes, it imparts to them an ethereal fragrance unattainable by any other means. Its price varies, being greatly affected by the available supply in the market, etc. Rimmel, an authority on perfumes, states that he has known it to be as low as 10 shillings ($2.50) and as high as 50 shillings ($12.50) per ounce. It is much dearer at the present time.

(3011) WATER-PROOF GLUE.—The following formulas for making marine or water-proof glue are both taken from reliable sources, and we think will answer our inquirer's purpose: Dissolve ½ ounce each of gum sandarach and mastic in 8 fluid ounces of strong alcohol (or methylated spirit), to which add ½ ounce of turpentine. Put the dissolved gums into a double glue-pot, add by degrees a hot, thick solution of glue to which isinglass has been added; stir the whole over the fire until all the ingredients are thoroughly incorporated. Next strain through a cloth while hot, and it is ready for use. It may now be returned to the glue-pot and ½ ounce of very finely powdered glass added to it. It should be used quite hot. Two pieces of wood joined by this glue may, when quite hard and dry, be immersed in water without fear of the joint opening or weakening. Another formula is the following: Take of shellac 3 parts; India rubber, 1 part, by weight. Dissolve each separately in ether free from alcohol. It is best to do this in stoppered bottles and without heating, as the ether readily evaporates. When solution is complete, mix the two, and keep well stoppered for use. This glue resists the action of water, both hot and cold, and most of the acids and alkalies. Pieces of wood, leather or other substances joined together by it, will break at any other part than at the joint thus made. If the glue be thinned by the admixture of ether, and applied as a varnish to leather along the seams where it is sewed together, it renders the jointed seam water-tight.

(3012) GILDING LEATHER.—Dampen the skin with a sponge and water, and strain it tight with tacks on a board sufficiently large. When dry, size it with clear double size; then beat the whites of eggs with a wisp to a foam, and let them stand to settle; then take books of leaf silver and blow out the leaves of silver on a gilder's cushion; pass over the leather carefully with the egg size, and with a tip brush lay on the silver, closing any blister that may be left with a bunch of cotton. When dry, varnish over the silvered surface with yellow lacquer, until it has assumed a fine gold color. The skin being thus gilded, may be cut into suitable strips or patterns. It should be carefully observed to have the skin well dry before sizing it. Bookbinders gild the edges, etc., of leather in a different way. They first go over the part intended to be gilded with a sponge dipped in the glair of eggs (the whites beaten up to a froth and left to settle); then, being provided with a brass roller on the edge of which the pattern is engraved, and fixed as a wheel in a wheel in a handle, they place it before the fire till heated, so that, by applying a wetted finger, it will just hiss. While the roller is heating, they rub the part where the pattern is intended to come, with an oiled rag or clean tallow, and lay strips of gold leaf on it, pressing it down with cotton; then with a steady hand they run the roller along the edge of the leather, and wipe the superfluous gold off with an oiled rag, and the gold adheres in those parts where the impression of the roller has been made, while the rest will rub off with the oiled rag.

(3013) SILVERING GLASS GLOBES.—We append several formalæ for silvering glass globes, etc., which this inquirer may find useful. To half an ounce of lead add half an ounce of fine tin, and melt them together in an iron ladle; when in a state of fusion, add half an ounce of bismuth, skim off the dross, remove the ladle from the fire, and before it solidifies add five ounces of quicksilver, and stir the whole well together, being careful not to breathe over it, as the fumes of the quicksilver are very injurious. The operation should be performed under a hood communicating with a chimney of good draft, to carry off the vapors. Or, to four ounces of quicksilver put as much tinfoil as will become barely fluid when mixed. Have the globe clean, dry and warm, and inject the metal by means of a clean glass or earthen pipe at the aperture, turning it about until it is silvered all over, let the remainder run out, and the operation is finished.

(3014) GILDING ON WOOD.—The most reliable directions for gilding on wood we find in the very practical "Work Manual" (No. III.), entitled "Hints for Painters, etc.," published by the Industrial Publication Co., New York. They are as follows: To gild in oil, the wood, after being properly smoothed, is covered with a coat of gold size, made of drying linseed oil mixed with yellow ocher. When this has become so dry as to adhere to the fingers without soiling them, the gold leaf is laid on with great care and dexterity, and pressed down with cotton wool. Places that have been missed are covered with small pieces of gold leaf, and when the whole is dry the ragged bits are rubbed off with cotton. This is by far the easiest mode of gilding. Any other metallic leaves may be applied in a similar manner. Pale leaf gold has a greenish-yellow color, and is an alloy of gold with silver. Dutch gold leaf is only copper colored with the fumes of zinc. Being much cheaper than gold leaf, it is very useful when large quantities of gilding are required in places where it can be defended from the weather, as it changes color if exposed to moisture; and it should be covered with varnish. Silver leaf is prepared like gold leaf, but when applied should be kept well covered with varnish, as otherwise it will tarnish. A transparent yellow varnish will give it the appearance of gold.

(3015) RUBBER-STAMP INK.—We notice the following recipe in one of our technical exchanges, which is recommended to give an excellent ink, and which, while not drying up on the pad, will not readily smear when impressed upon the paper: Aniline red (violet), 90 grains; boiling distilled water, 1 ounce; glycerine, ½ a teaspoonful; treacle, half as much as glycerine. The crystals of the violet dye are to be powdered and rubbed up with the boiling water, and the other ingredients must be stirred in.

(3016) ACID IN MACHINE OILS.—One of the simplest and readiest off-hand methods of detecting whether a sample of machine oil contains free acid, is to cover some oxide of copper in a glass with a layer of the oil (coppersmiths' ash will answer the purpose). If the oil contains either free fatty or resinous acid, the cuprous oxide will be attacked, and the oil will show in a short time a distinct green coloration. Gentle heating facilitates this action.

(3017) SUBSTITUTE FOR SAL-AMMONIAC.—The only substitute for sal-ammoniac that we know of, is what is called commercially "muriate of ammonia," which is very commonly in use among the galvanizers of the Eastern States. It is substantially the same as sal-ammoniac, only somewhat less pure, being probably contaminated by the presence of some organic matter. It corresponds in appearance and color to the material our correspondent describes. It is imported from Liverpool, and costs about 8½ cents per pound; while sal-ammoniac is likewise imported, and sells for about 11 cents per pound, and does not answer the purpose any better.

(3018) STAINING THE SKIN.—We are averse to giving advice to this correspondent, and would suggest as his most sensible course that he consult a physician. As he states that he enjoys good health, it is probable that the "ghastly paleness" of which he complains, is due to the fact that his skin is not performing its functions properly, and his family physician would be the proper person to consult. He might possibly be able to prescribe some simple mode of treatment that would restore the skin to its healthy condition. There are several applications to the skin, that are not hurtful, that might answer our inquirer's purpose. Of these, perhaps the best would be tannin tincture. If he is determined to make an external application, let him procure some of this, and try the effect of a little on his hands first. Pour a little of the tannin tincture into water and cover a portion of the hands with it, noting the effect after some hours. He can thus get the right quantity of tincture to add before venturing to use it on the face. A decoction of gall nuts, or sumac, will answer the same purpose. By making a decoction of walnut hulls, and using a small quantity of this in water from time to time, he may perhaps accomplish the same purpose. In either case, he should make very sure by experimenting on his hands, before venturing to apply the stain to the face.

(3019) GELATINE MOLDS.—We are not able to say if the preparation for elastic molds is sold ready for use, but do not think it is, for the reason that it is very easy to prepare. A simple receipt is, glue, 12 ounces; molasses, 3 ounces. Soak the glue in sufficient cold water to render it quite soft, then heat gently until the glue is quite liquid; add the molasses, and mix the materials well together. The plaster cast should be thoroughly saturated with linseed oil, containing some dryer, and laid aside for a day or two, to harden before the elastic mold is made from it. "Smee's Electro-Metallurgy," or "Napier's Electro-Metallurgy," are both reliable standard works, and contain much information on the subject of making molds. The price of the latter is $3, postpaid. We can furnish "Cameron's Plasterer's Manual" for 75 cents, postpaid.

(3020) COFFEE CULTIVATION IN THE UNITED STATES.—We have been informed, though our authority is not the most reliable, that the coffee plant has been domesticated in California since the year 1873. To which our informant adds, it has become very productive, yielding a bean of strong aromatic flavor, and growing as vigorously as in the coffee countries of South America. It is reported to us that there are extensive plantations of coffee in Central and Northern California paying their owners a handsome profit. We have been informed of no other locality in the United States where the raising of coffee has been attempted, though it may perhaps be grown elsewhere. Our inquirer is advised to write for reliable information on this subject to the Department of Agriculture, Washington, D. C.

(3021) PUBLIC LIBRARIES.—Replying to this correspondent, we can inform him that the Bureau of Education, Department of the Interior, published in the year 1876 an elaborate work, in two volumes, entitled "Public Libraries in the United States of America; their History, Condition and Management. Special Report. Department of the Interior, Bureau of Education. Washington: Government Printing Office. 1876." This work, of over 1,000 pages, forms a very complete history of the libraries of the country as they were in 1876. It should be accessible in every public library.

(3022) EFFECT OF SUNSHINE ON A FIRE.—The belief that letting the sun shine on a fire will put it out, is very general, but has no foundation in fact. It has probably originated in an optical illusion. A fire in a grate, for instance, viewed in a darkened room, looks brightly glowing by contrast with its darkened surroundings; while the same fire viewed with the sunlight streaming upon it and brightly illuminating its surroundings, loses the hightening effect of contrast, and appears dull and sluggish. Darken the room again, and the fire brightens up at once. It is probably upon this illusory appearance that the popular belief is founded. That there is no truth in the belief, any one may satisfy himself or herself by simply trying the experiment fairly. The only effect that the sunlight would have would be to slightly rarefy the air surrounding the fire, by warming it, and might after a considerable time slightly affect the rapidity of combustion; but as to putting the fire out, the idea is absurd.

(3023) TRANSPARENT COLORED VARNISHES.—The aniline colors are particularly well adapted for the preparation of transparent colored lacs, which possess great intensity even in very thin films, and are consequently very suitable for coloring metallic objects, mica, glass, etc. We have called attention to this fact in several answers in this department during the past year or two. Springmühl recommends the following procedure: He proposes separating a concentrated solution of the aniline color in alcohol, and another of the gum, using either bleached shellac or sandarach. When the lac is to be used, pour enough of the two solutions together for the purpose. The metal, glass or mica should be quite dry and slightly warm. Colored films of great beauty can also be obtained, according to the same authority, by similar colored solutions of collodion cotton in alcohol and ether. The collodion film has its elasticity very much increased by the addition of some turpentine oil; and when applied cold, may be removed entire. The colored films may now be cut into patterns and attached to any surface.

(3024) INDELIBLE INK.—It is probable that the practice of laundrymen may be to use washing liquors containing considerable more alkali than is the practice in the household. If this is the case, the rapid eating out of the places marked with indelible ink would be easily explained. The indelible ink usually acts by the reduction of nitrate of silver by contact with the fiber, the result being the deposit of a brown or black oxide or sub-oxide of silver in the fiber, which is ineradicable. This action, however, causes a partial destruction of the fiber, and leaves the texture weaker than the other parts of the fabric. The combined action of strong alkali on these stained parts would be likely to effect the destruction of the colored fiber far more rapidly than the use of mild soaps. If our correspondent gets good results from the use of draftsman's India ink, we should say by all means adhere to it. There is nothing in this ink to act chemically on the fiber, as it consists of carbon in an impalpable state of division; and if he finds it to be sufficiently permanent for practical purposes, we should say it was to be preferred to anything else. We add a good receipt for making an indelible marking ink, though we are not prepared to guarantee that it will stand laundry washing: Dissolve 1 ounce of nitrate of silver and 1½ ounces of crystallized carbonate of soda in separate portions of distilled water, and mix the solutions; collect the resulting precipitate in a filter, wash it thoroughly with distilled water, and introduce it while still moist into a stone mortar; add 8 scruples of tartaric acid, and triturate the whole until effervescence has ceased; next add sufficient ammonia to dissolve the tartrate of silver, mix in 4 fluid drachms orchil, 4 drachms of white sugar and 12 drachms of finely powdered gum arabic; then add sufficient distilled water to make 6 ounces of the mixture. This ink is said to fulfill all the conditions that a marking ink should possess. It flows freely from the pen, without running or blotting; it does not require a very strong or long continued heat to develop it; when developed, it is perfectly black, and it does not injure the texture of the finest fabric.

(3025) PORTABLE HOUSES.—There is such a company in this city at 335 Broadway—the Portable House and Manufacturing Company. They make sectional houses of many sizes and descriptions, varying in price from $100 upwards.

(3026) SPRUCE BEER.—A good recipe for spruce beer is the following: To 3 gallons of boiling water add ½ pint essence of spruce, 5 or 6 ounces of ginger root (bruised), and 5 or 6 ounces of hops. Boil for about a quarter of an hour; then add 3 quarts of molasses and 11 gallons of warm water. When lukewarm, add 1 pint of brewer's yeast. Allow the liquor to ferment for about twenty-four hours; then add the whites of two eggs well beaten up, let it stand till clear, then bottle and wire the corks. If desired to make a light-colored beer, use about 10 pounds of white sugar in place of the molasses. We also give another recipe: 2 ounces of hops, 10 gallons of water, 2 ounces of chip sassafras; boil half an hour, strain, and add 7 pounds of brown sugar, 1 ounce essence of ginger, 1 ounce essence of spruce, ½ ounce ground pimento. Put into a cask and allow to cool, then add 1½ pints yeast, let it stand twenty-four hours, and bottle.

(3027) GRISCOM'S ELECTRIC MOTOR.—The address of the proprietors of the Griscom motor is, The Electro-Dynamic Motor Co., 123 South Third street, Philadelphia, U. S. A.; or, William Harding, President Electro-Dynamic Motor Co., Inquirer Building, Philadelphia.

THE MANUFACTURER AND BUILDER,
A PRACTICAL JOURNAL OF INDUSTRIAL PROGRESS.
Vol. XIV.—No. 7. JULY, 1882. Fourteenth Year.

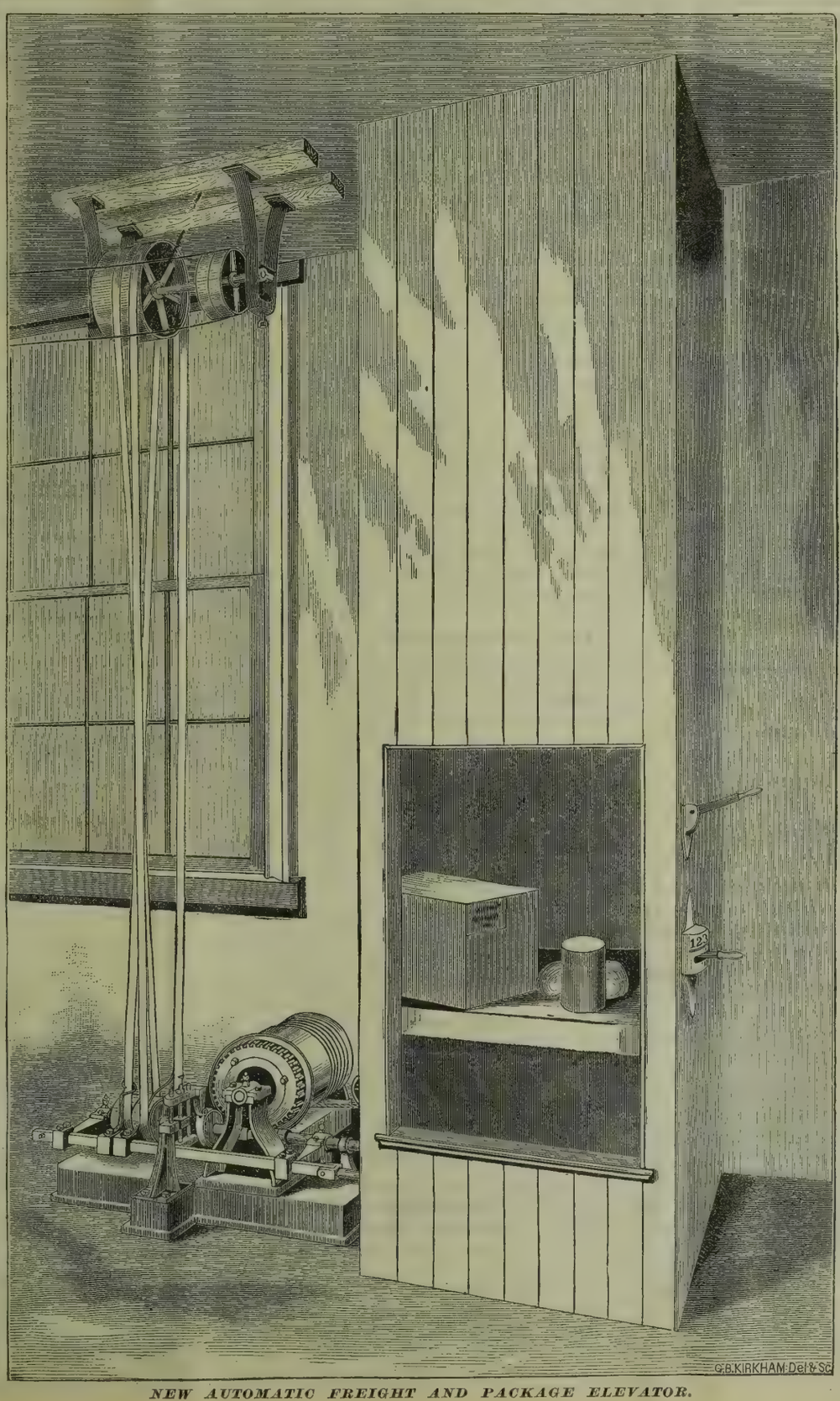
Automatic Freight & Package Elevator.

It can hardly be doubted that in all the cities and larger towns, many business houses, hotels, manufacturing concerns, etc., would use elevators to assist in the prosecution of their daily work, could the great expense of attending and operating them be done away with. As heretofore constructed, no elevator could be operated without the constant attendance of a man or boy, whose business it was to go with the platform and stop it when or where desired, and also to make regular or stated trips. At the best this was quite an expense, amounting in many instances to far more than the cost of the power necessary to drive the gearing, and also the cost of keeping everything in repair. Again, the frequency of accidents from elevators used wholly or partially for freight purposes, has deterred many from adopting them.

It is true that many more or less satisfactory arrangements have been devised and erected to partially meet the wants, but most of them are slow in operation, expensive to keep in order, uncertain as to results, and frequently preventing rather than assisting the objects for which they are intended.

In many instances, elevators which are known to be unsafe, are still used, where precaution is taken regarding the attendant riding upon the platform, and communication is made by use of stairways to the floor at which the elevator car is to stop, and then waiting for its arrival.

All these are large items of expense, and have been instrumental in the inventing and perfecting of the elevator which we illustrate on this and the second page, and which has been brought out by the Tewksbury Automatic Elevator Co., 60 Temple Court, New York city.



NEW AUTOMATIC FREIGHT AND PACKAGE ELEVATOR.

This elevator is intended for light freight and package business, in any and every situation, and for any service where a hoist, lift or dumb-waiter can be used. It can be dispatched to any floor of the building, be recalled, and sent in either direction up or down, without any attention, except to start it, when it will in every case stop exactly where desired. It can then be relieved of its load and sent back, or receive additions and be sent still further up until its extreme is reached—all this being controlled from any one or all of the floors in the building.

Referring to the engravings, the one given on this page shows the elevator set up and in the act of ascending, the box or car carrying a load. Figs. 1 and 2 show in section the special automatic arrangement which controls the operations of the car. As to the running gear or driving mechanism, it has no especial points of difference over other elevators of heavier class, save in the brake, which we shall describe farther on.

The motion is obtained by means of a steel worm running in an oil chamber or box (to serve as a positive lubricant), which drives an accurately cut bronze worm wheel attached firmly to the drum or rope wheel. The reversing motion is obtained by the usual method of tight and loose pulleys. The guides, which extend from the bottom to the top of the building, are made of wrought iron sections, firmly bolted together and

braced at each floor, thus doing away with the usual wooden posts and cast iron guides, which are ever subject to displacement through shrinkage or through settling of buildings, etc. At the top and bottom of the car or platform are grooved wheels, turned to fit the angle of the guides, which wheels are kept firmly to their places by means of heavy springs, thereby preventing any side or uneven movement of the car, and doing away with friction, owing to their rolling motion.

Figs. 1 and 2 give in detail the automatic features, which are shown at the right of the principal engraving as being placed outside of the sheathing which surrounds the well or opening. As these parts will be securely bolted to the wrought iron guides, the well can be left open its entire distance and protected by railing or fence, and a platform be used instead of a box or car, as desired.

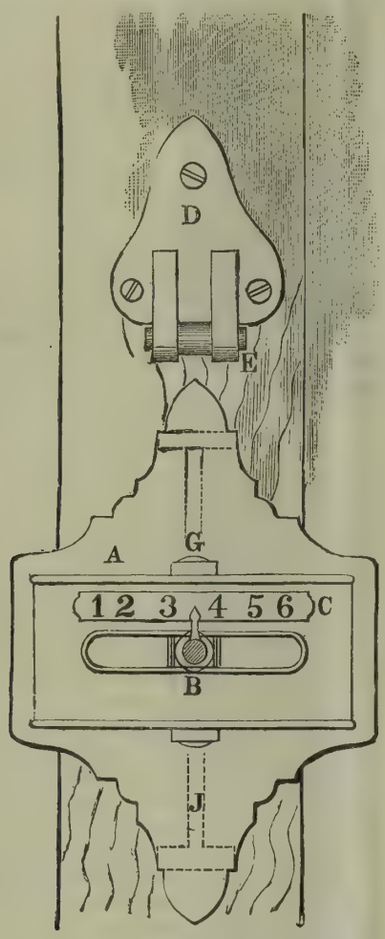


Fig. 1.

Referring to the sectional engravings, the rod J, which is of cold-rolled iron, extends from the top to the bottom of the lift, being supported in such a manner as to be free to be moved vertically up or down, at the same time rotated. Sufficient couplings are used to make the rod rigid its entire length. The bottom of the rod J is connected to a lever, which in turn is connected to the shifting rod, through which the belts are shifted to change the motion of the car or bring it to a rest. To put the car in motion, the lever F, Fig. 2, is moved in the direction it is desired the car should take. This lever is hinged at E in the bracket D, and the inner end forked over the rod J, to which it is attached by means of the loose collar L, the links K and the two tight collars just above and below the loose collar. This forms an attachment which permits the rod J to be moved up or down, and at the same time to be rotated. At the extremes—that is, the top and bottom—of the rod J are tight collars, which are of such a construction as to positively stop the car and prevent it from passing beyond its limits. The automatic stopping at any intermediate floor desired is accomplished by the tappets M, which correspond to the number of floors. These are firmly fixed to the rod J, each one occupying a position vertically corresponding to its floor, and all radiating in different directions from a common center. Only one of these tappets can be brought into effective position at a time, and only such a one as corresponds to the floor intended. For the instant and positive adjustment of these tappets, a small pinion I is attached to the rod J, as shown, into which pinion the segment H gears, free to be moved laterally by the handle B on the trunnions G in the case A, upon which are figures to correspond to the various floors. By moving the handle B to any special figure, as, for instance, figure 4, the tappet which represents the 4th floor is brought into position and the stop or lug upon the car or platform strikes the tappet and the car is brought to a full rest at the exact position desired. Each floor is provided with a separate indicator, and also a starting lever, and all show precisely alike, so that the operators on any one floor can tell the exact standing of the indicators on every other and see which direction the car is taking and where it will stop, enabling them, if desired, to hold it, add to the load, and dispatch it to its destination.

In connection with the running gear is a powerful friction brake, operated by a toggle-joint lever, which, by a cross-head, is attached to the shipping rod, so that when the belts are shifted by the action of the rod J, as shown, the friction is brought to bear direct upon the driving shaft, instantly stopping the car without shock or jar.

Just before reaching its destination, notice of its approach is given by the ringing of an electric bell. The entire arrangement of all the parts is extremely simple, and cannot be disarranged under any circumstances, neither can any damage ensue by two or three attempts being made at the same moment to use it on different floors.

Every attention has been paid to perfection in manufacture, none but the best materials being used and the workmanship first-class in every particular. The worm is of steel, accurately cut by a hob; the worm wheel is of hard bronze, and the shifting lever of wrought iron. The hubs of the loose pulleys are furnished with self-oiling bronze bushings, so constructed as to have four separate oil chambers, which supply automatically sufficient oil for several weeks' use.

The running gear or driving mechanism need not be situated on the floor as shown in the engraving, but may be placed in any position, whether on the wall or ceiling, or directly over or beneath the opening or well. It requires very little power to drive it, and those of lighter capacity may be profitably employed even where larger ones are now used, as to run a large elevator empty requires more power than this one loaded, besides the economy in the way of attendance.

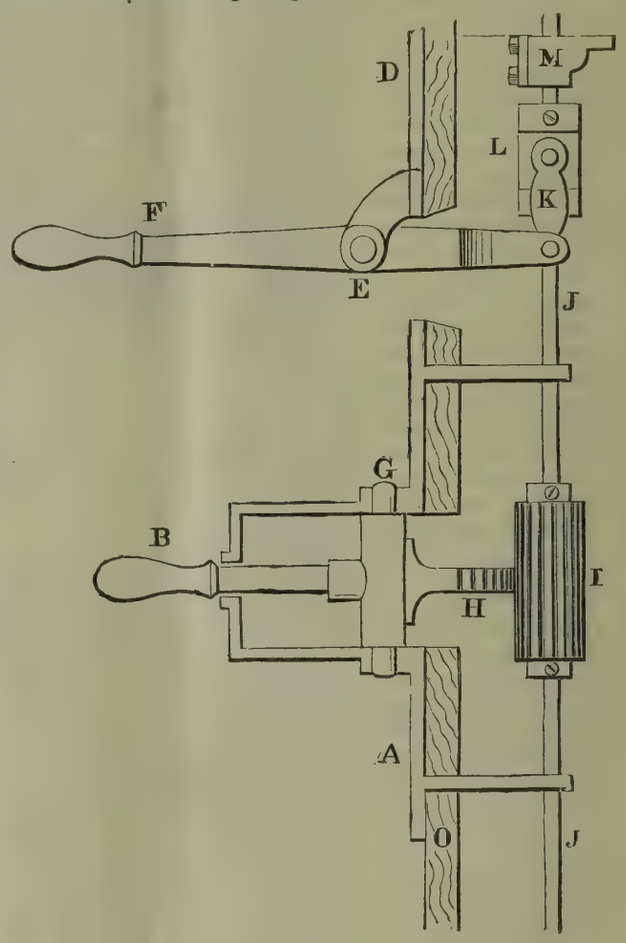


Fig. 2.

The Walworth Manufacturing Company.

Our attention has been called to some interesting facts in relation to the business and products of the Walworth Manufacturing Company, of Boston, a brief review of which we take pleasure in laying before our readers.

This company, which, as a corporation, is but ten years old, is the outgrowth of the late firm of J. J. Walworth & Co., formerly Walworth & Nason. For more than forty years the company and its predecessors have been engaged in the manufacture of tools and materials of every description employed in steam, gas and water works. In addition to this extensive range of articles, the company holds a leading position in the manufacture and construction of steam and hot-water warming and ventilating apparatus. James J. Walworth and Joseph Nason, composing the firm of Walworth & Nason, who commenced business in 1842, were the founders of this concern and the pioneers in this kind of business in the United States. They were the originators of the use of small wrought iron tubes for warming buildings by steam. Most of the methods and peculiar appliances now so extensively in use throughout the country in that business owe their origin to this firm.

The eminent position occupied by this company as one of the foremost manufacturing concerns of its class in the country, and its steady growth from very modest beginnings, is due in a great measure to the business energy and the mechanical skill of its founders and those who have since been immediately connected with its business and mechanical departments.

The works of the company are located at South Boston, and give employment to about 400 workmen. The sales warehouse and business offices are at 69 Kilby street, Boston. About 150 workmen, in addition to those at the works, are employed in various capacities connected with steam heating, gas lighting and other kindred branches.

The executive officers of the company are, J. J. Walworth, President; C. C. Walworth, Vice-President and general manager of the mechanical department; and E. C. Hammer, Treasurer.

Utilizing the Tides.—Arthur Oates proposes to utilize tidal energy for motive power by means of a dam, or weir, constructed across a tidal inlet, or in any position where it would exclude the water until about the time of high tide, when the fall of the water into the inclosure would be utilized by motors of some suitable kind. Again, the water in the inclosure would be retained until low tide, when its fall or rush-out would be utilized by motors as in the former case.

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Vol. XIV., No. 7. Fourteenth Year.

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The Government Engineers on Mr. Lawson's Experiments.

Since the publication of our June issue, we have been favored with a copy of the official report of the government experts appointed to witness and report upon the experiments with steam boilers made by Mr. D. T. Lawson, lately reported and commented on in this journal. The first report, which relates circumstantially the facts and details concerning the boilers and their appurtenances, and the events attending the experimental tests, we have already laid before our readers. The second report, with which we have here to do, is much more interesting, in that it gives the opinion of the government engineers upon the merits of Mr. Lawson's theories as deduced from the experiments referred to.

The report indicates that the government experts have been fully convinced of the correctness of Mr. Lawson's views respecting the explosion of steam boilers, and of the great value of the method of construction advocated and employed by him as a preventive. Their endorsement of Mr. Lawson's views and plans is complete and unqualified, and it places him before the engineering world in the strongest possible position. No engineer in the face of this emphatic triumph of Mr. Lawson may now presume to ignore the man or his theory. The latter will take its place by general consent as an important factor in contributing to steam boiler explosions; and though it may not be accepted at the full valuation which the excusable enthusiasm of its able expounder places upon it, it will undoubtedly command respectful attention in all future considerations of the subject to which it relates, and play an important role. For, having shown the engineering world by the irrefutable logic of experiment the true value and importance of an active element in the causation of steam boiler explosions, which had heretofore been considered of such trifling, or questionable, importance, that it had been passed by with brief comment, or, in most cases, completely ignored, Mr. Lawson has rendered a marial service to science, and one which will not soon be forgotten.

The government engineers, however, go further than this. They not only admit the entire correctness of Mr. Lawson's views respecting the origin of steam boiler explosions, but they unanimously endorse the method of boiler construction (see pages 108 and 109 of our May issue) which Mr. Lawson proposes as an effectual preventive. His triumph, therefore, is as complete as he could have wished.

The major portion of the report here referred to, dwells upon Mr. Lawson's system of boiler construction (the introduction of the perforated diaphragm referred to in our earlier article), and has a special interest for us on that account, since it expresses very decided opinions on a number of points concerning which we have entertained doubts. The report starts out with the comprehensive statements, that, in the opinion of the commission, the construction of steam boilers on Mr. Lawson's plan not only adds materially to the strength of the boiler, but insures greater safety in its use and management. They affirm that where it is used there can be no sudden disturbance of the water by the sudden opening of the throttle valve, or from any other cause by which steam is suddenly removed from the boiler and suddenly checked. They assert that the validity of Mr. Lawson's claims respecting his theory of steam boiler explosions is fully established.

Referring to the experiments in substantiation of their opinion of the utility of the diaphragm, the engineers make the following strong presentation of the case in favor of Mr. Lawson: "Another proof of the utility of a diaphragm, such as, or similar to, the one employed in making the experiments, is the fact that the boiler containing the diaphragm carried a pressure of 300 pounds to the square inch without producing any weakness whatever in any of its parts, notwithstanding the throttle valve was opened repeatedly during the test, while, after the center of the diaphragm was removed so as to allow a free and unobstructed passage of the steam from the water to the steam space, the boiler exploded with a pressure, at the time the throttle valve was opened, of 235 pounds. (The manner in which the opening was made could not have materially weakened the boiler). The explosion was not confined to any particular part of the boiler; but at the very instant the throttle valve was opened the boiler was blown to pieces. The manner in which the iron was torn, simply places it beyond our ability to estimate with any degree of reliability the force exerted at the instant of explosion. We are convinced that the attachment to a boiler of a diaphragm such as, or similar to, the one employed while making the experiments, will, in a great measure, remove the dangers which now surround the management and use of steam boilers. A boiler with such an apparatus attached is safer, for the reason that no concussions can take place in it. Aside from this, it strengthens the boiler, and in addition thereto it produces dry steam—a great desideratum in the running of steam engines."

We are disposed to give Mr. Lawson the fullest credit for his services in connection with the important problem he has taken upon himself the task of solving, and will be most happy to be able to record any facts which bear out his views, or which demonstrate the practical utility of his mode of constructing steam boilers.

There is still one unsettled point which time alone can settle—namely, how the Lawson system of boiler construction will stand the test of usage. If it shall be found to stand the test of service without impairing its utility, we shall be prepared to give it a hearty endorsement. Thus far Mr. Lawson has discomfited all his critics—facts are stubborn things to deal with—and thus far they have all been ranged on his side. Mr. Lawson has our congratulations upon the well-earned triumph that he has thus far achieved. We trust he may persevere

Amending the Patent Laws.

Apropos of our remarks in our last issue on the effort made by the enemies of the existing patent laws of the country to so amend them as to emasculate them of every element of protection for the inventor, we have had the opportunity of hearing a verbal report from the committee appointed by the Franklin Institute to proceed to Washington and lay before the Senate Committee on Patents, the protest of the Institute against the proposed amendment. From this report, which contained many interesting points, it appears that the strongest opposition to the patent system emanates from two powerful organizations, known as the Western Railroad Association and the Millers' Association, both of which avow their open hostility. When it is considered how much the business represented by these organizations has profited and benefitted by the numberless patented inventions which they have introduced from time to time, their attitude towards the inventors of the country is not one which speaks highly for their fairness or honesty of purpose.

Again, it was pointed out that there was a strong opposition to the patent system among the farmers of the West, among whom the foreign element is largely represented. These men have somehow become possessed of the notion that the patent system operates to their detriment, and many of them, through ignorance, are opposed to the system of patents in any form. The folly and inconsistency of such stupid prejudice were forcibly shown in the report, when the spokesman of the committee remarked that no class of our population owed so much of their prosperity to, or were so completely dependent upon, the patent system of the country as these very farmers of the West, who, without the aid of the numberless patented inventions in agricultural machinery, and in devices and machinery for facilitating and cheapening transportation, could neither sow their seed, reap their crops, nor send their grain to market.

Another member of the committee made the announcement that the strength of the opposition to the patent system in Congress was greatly underestimated. He affirmed that the large vote by which the recent obnoxious and destructive amendment had passed the House of Representatives, was not, as many

have charitably supposed, cast hastily and without due understanding of its crushing effects upon the inventor class, but expressed the deliberate convictions of most of those who voted in its favor. He added to this that he was satisfied, from personal knowledge gained by his intercourse with members of Congress, that it was only a fortunate accident that prevented this destructive measure from having been put through the Senate with perhaps as large a majority as it had commanded in the House. This accident was the fact that a majority of the Senate Committee on Patents happened, most fortunately, to be composed of members who were favorably disposed towards the existing patent system.

These statements are full of instruction and warning to the inventors of the country. The facts brought out by this committee show the existence of several powerful organizations, with abundance of money at their disposal, and prepared to use every means at their command to break down the protection which the patent laws give to the inventor; they show a widespread opposition among the farmer element, the last, it would be supposed, to be found in the ranks of the opposition; and, most dangerous of all, they show that the sentiment of Congress is against them.

The strength of this opposition is so formidable, that it would be a grave error to ignore or undervalue it. Though defeated by a fortunate chance at this session of Congress, the enemies of the patent system will make a fresh onslaught at the next session, and it behooves the inventors and manufacturers who are jointly interested in the maintenance of the patent system of the country to see to it that their imperilled interests shall be boldly and strongly defended.

The Steam Street-Car Problem.

Late advices from Paris report the fact that the managers of the street-car lines of that city, after persistent and continued experiments continued for the past five years, during which time they had tested the merits of no less than twenty-one forms and modifications of steam motors, have finally abandoned the attempt and gone back to horses.

Such a conclusion appears to be contrary to our accepted notions of progress, but it is practically the same result as that reached several years earlier by the street-car companies in a number of American cities. The conclusion is to be regretted, as the substitution of some economical motive power to take the place of animal traction for this service would be attended with many advantages from a sanitary and humanitarian standpoint. Perhaps the electric railway, which has lately been successfully introduced in Berlin, and which is spoken of with much enthusiasm by all who have had the opportunity of witnessing its operation, may be the initiation of a departure that will ultimately solve the vexed question.

Whatever the future may have in store for us in this direction, it appears to us that, with the benefits of the experiments and failures with steam in Paris, and in our own cities, inventors should find the problem of devising a safe, practical and economical motor for street cars not impossible to solve. The cable system in vogue in Chicago is highly spoken of, and seems to have proved a very satisfactory method. It may, in fact, be the practical solution of the problem, though we do not know enough of the details of its operation to venture a decided opinion on the subject.

The capabilities of compressed air engines for this species of service, it seems to us, have not been sufficiently considered by those who have turned their thoughts to the solution of the street-car problem. The system is free from most of the objections that are properly urged against the use of steam. It would dispense with the cumbersome and uncomfortable adjunct of the steam boiler, which of itself would be a signal advantage, even if it possessed no others.

The present state of quiescence into which the consideration of the subject has fallen should not be interpreted as an indication that public interest in it has been lost. On the contrary, the demand for such a reform will grow more and more urgent from year to year, until the right solution of the problem has been found.

The Labor Strikes.

For the first time since the summer of 1877, made memorable by the great railroad riots, there are symptoms of a general disaffection among the working classes, which has manifested itself in the organization of extensive strikes for higher rates of wages. These have followed each other with such rapidity and method that they would appear to have been the outgrowth of a plan carefully and deliberately considered in advance by the great labor organizations that of late have grown powerful and aggressive. The iron manufacturing and railway interests, among the most important of the country, and the most vulnerable to attack, have, as usual, been made to bear the brunt of the conflict. What the outcome will be it is difficult to foretell with certainty, but it is more than probable that, as is nearly always the case, the men will lose in the end. Both the time and the conditions of trade are unfavorable to them. There has lately been a lull in the iron trade—a natural reaction from the extraordinary activity of the previous year, and one that was the inevitable consequence of a poor-crop year and the collapse of numerous and vast speculative operations. On this account, and also because of the existence of a large stock on hand, the iron manufacturers can look with comparative serenity upon the situation, consoled by the reflection that the leaders of the labor organizations could not have chosen a time to precipitate the conflict that would have caused less of inconvenience and loss to the masters, than they did.

So far as their ability to withstand an organized labor conflict, the railroads, in consequence of the disastrous war of rates carried on during the past year, are not in so strong a position financially as they should have been; but another element in their favor, which the movers in the strikes must have overlooked, and which more than counterbalances their weakened financial condition, is the continual flow of immigration to our shores. Last year, for example, immigrants landed on our shores at the unparalleled rate of nearly 2,000 per day; and this year they are pouring in still more rapidly. These new comers are made up largely of men in the vigor of life, and who are therefore available for immediate employment.

The trades unions have had time to replenish their coffers since the disasters of the panic years 1873–'77; but we gravely question whether the result will not prove the present movement to have been an act of supreme folly. It must be admitted, to the honor of the strikers, that their movements have been in the main quiet, orderly and dignified, and that but few instances of violence and intimidation have had to be recorded against them; but the initiation of the great strikes of the iron workers, and of the freight handlers, which are in progress at the present time, involved in both cases a discreditable breach of faith. The iron workers rejected plans for arbitration that they themselves had suggested and approved; and the freight men, without even the formality of asking for the additional pay they now demand, abandoned their work, apparently thinking that they could easily coerce the companies into compliance with their demands. In this the men were seriously mistaken, and the indications at the present writing, are that this strike at least will terminate in complete failure for the strikers.

Irrespective of the merits of the issues for which the present warfare is being waged, it is certain, if long continued, to entail great disaster, suffering and misery upon the laboring classes who engage in it, and on this account will be regretted by all. As regards the iron trade, however, it may be productive of results more far-reaching and calamitous than the organizers of the strike have dreamed, for whatever be the issue, the fight cannot but aid the British iron trade to the detriment of ours. The English papers are already jubilating over the prospect. One of them, that is notorious for the virulence of its enmity against everything American, puts the case in about this style: "If the men succeed, the increase in wages obtained will cause a rise in prices, and with the rise of prices the export of British iron to the United States in large quantities will become possible. Even last year there was somewhat over three-quarters of a million tons of iron imported into the United States, and, if prices were now to be raised, the import would be enlarged until prices rose here also to counterbalance the rise in the United States. Even if the men are defeated, and wages remain as they are, a rise in price is inevitable, provided the strike continues for a month or two. The cessation of production in all the great iron districts in the United States for several weeks, would give time for the exhaustion of the stocks on hand. Last year, as we have already said, over 9,000 miles of railway were made, and this year the rate of construction so far is still more rapid. Besides, there were at the end of last year more than 103,000 miles of railway in the United States, and this vast mileage requires constant renewals, which use up a large amount of iron. But if production is suspended for several weeks, while railway building and railway repairing go on, and stocks are thus greatly reduced, prices must rise; and a rise of prices will open the door to foreign imports, and will thus give an impetus to the British iron trade."

With the prospect of the wholesale blowing-out of furnaces and shutting down of mills, which the flooding of the country with British iron would imply, the victory of the men would be a barren one indeed. It is a subject of infinite regret to right thinking men that there should be no better plan of adjusting differences between employés and employers than the destructive and suicidal resort to the strike. In the vast majority of cases, the strikers fail in their object, and the misery, wretchedness and suffering it entails, fall with terrible severity upon the dependent families of the wage earners.

If half of the executive ability and zeal displayed in organizing lodges, unions and the like, were spent in devising plans for the equitable arbitration of disputes and differences, the strike would be a thing of the past.

To Europe in Less than Seven days.

The limit of possibilities of speed in the transit of the Atlantic, does not appear to have yet been reached, and with the steady improvements that are being made in the construction of vessels, in giving finer lines to their hulls, and furnishing them with engines of increased power, we may look for steady reduction of the time of passage.

The latest candidate for nautical honors, in respect to speed, is the steamship "Alaska" of the Guion line. This fine vessel had made the fastest trip on record in one of her late passages from England to America, but on the return trip succeeded in beating her own record by several hours. The trip from Sandy Hook to Queenstown was made by the "Alaska" in less than seven days. She sailed from New York on May 30th, clearing Sandy Hook bar at 5.28 P.M., and arrived at Queenstown at 8 P.M. on Tuesday, June 6th. Deducting 4 hours and 22 minutes for difference of time, the actual time of the trip was 6 days, 22 hours and 10 minutes.

The *Tribune*, in commenting on this remarkably rapid voyage, brings the feat into instructive prominence by recalling the fact that in 1848 it was considered remarkable that an ocean steamer should make the Atlantic passage in less than sixteen days.

The Hartford Engine.

Of the numerous types of automatic cut-off engines in use to-day, and which represent in their design and construction the most advanced practice in using steam as a motive power effectively and economically, none is better known, or has a higher reputation among steam engineers, than the Hartford automatic cut-off engine, manufactured by the Hartford Engineering Co., of Hartford, Conn. This engine embraces in its design many of the typical features which have gained for the Buckeye engine the high and deserved reputation it holds; and in addition, it embodies a number of improved features which materially add to its effectiveness.

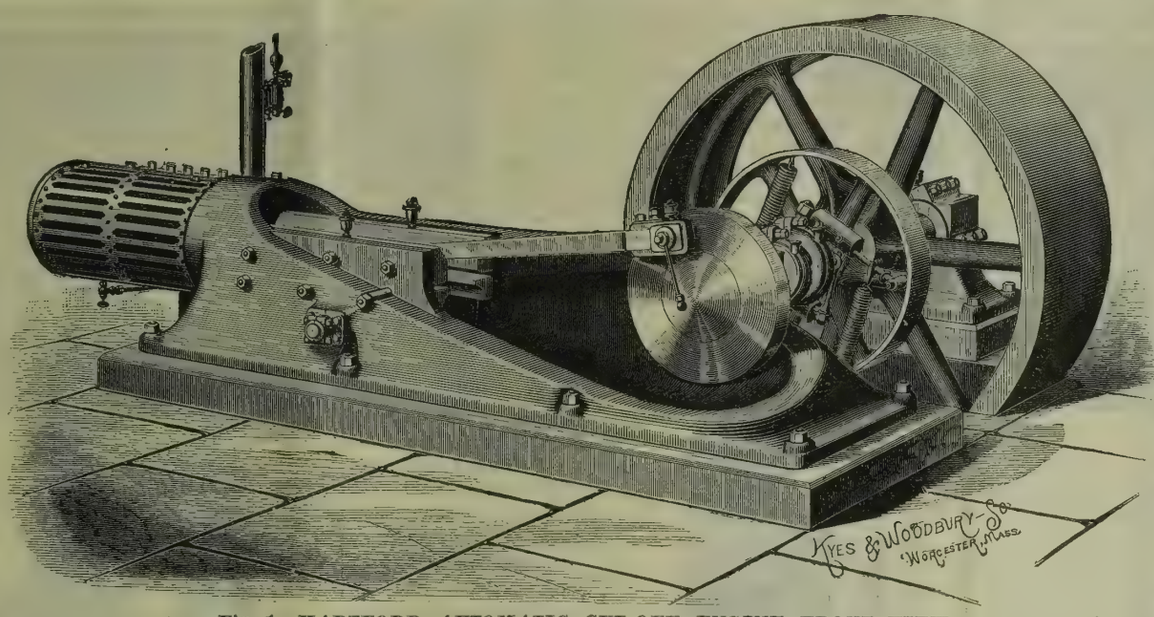


Fig. 1.—HARTFORD AUTOMATIC CUT-OFF ENGINE—FRONT VIEW.

We show in Fig. 1 a front view of the Hartford engine in perspective, from which a very good general idea may be had of its typical features. One feature which will attract the immediate notice of the critical observer, is the extreme massiveness of the bed, which, for high-speed work, is a point of prime importance. The general form of the bed is rectangular, and the spread upon the foundation is very broad. To insure the transmission of strains from cylinder to bearing in a straight line, special attention has been paid in the design of this engine to keep a large amount of the metal of the bed above the "load line," or center line, of the engine; while the rigidity of construction is further insured by providing a massive hood over the cylinder end, connecting with a heavy rib down the front of the bed. The main bearing is strongly buttressed, and the inside of the bed is hollowed to catch any drip of oil.

Referring to the valve mechanism, the cut-off valve consists of two light plates connected by rods, and working on seats inside the main valve, and which by their movement alternately cover the ports leading to the cylinder. The valve stem works through the hollow stem of the main valve. The exhaust takes place at the end of the valve into the valve chest, and an exhaust pipe below. Among the notable improvements that have been introduced into the engine by its makers, are relief chambers in the valve seat, by which the valves are balanced. By these devices a moderate and very nearly uniform pressure on the seats is insured at all points of travel, and the proper distribution of lubrication is greatly assisted.

The governor is designed to secure a neat appearance with great accessibility. Side draft is avoided; the leverage of the spring, as well as of the weight, is made adjustable, and the point of attachment of the spring has been placed in a modified position, in order to secure a refinement of isochronal regulation—a valuable feature, which, however, cannot be detailed here. The governing device is remarkably simple and effective. Without the aid of sectional views of parts, it will be impossible for us to refer more particularly to details, which would be of special interest to our mechanical readers. We may add the fact, however, respecting the range of adjustment, that when the earliest cut-off that the action of the regulator can produce is no earlier than is necessary to restrain the engine under its lightest load and greatest steam pressure, the latest will be at ⅝ to ¾ of the stroke, where it meets the fixed cut-off of the main valve, due to its lap and angular advance; and this whole range of adjustment is under complete control of the governor. To appreciate the value of this feature, it should be understood that, with single eccentric releasing gear movements, the governor can only control the time of release during the opening movement of the valve, which necessarily terminates before mid-stroke, so that if the release is not effected before the mid-stroke it will not take place at all during that stroke, thus causing extravagant expenditure of steam and spasmodic irregularities in the motion. Furthermore, respecting the valves, it may be noticed that the engine can be run for inspection with the cover of the chest removed, so that any leakage of the valve may be detected and located. This feature is important, in that it allows the valve to be fitted tight in the first instance, which is done in the shop under 80 or 90 pounds steam pressure, and repeatedly scraping them until all leakage disappears; and it enables the engineer, also, to inspect their condition at any subsequent time. When the difficulty of fitting a valve, and particularly a balanced valve, steam tight, is considered, the advantage afforded by the opportunity for inspection is an important one.

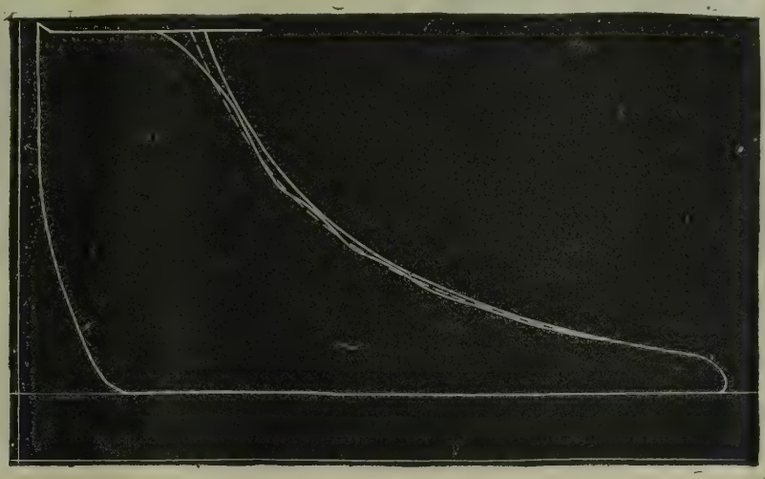


Fig. 2.—Minimum Load for Best Economy.

It is claimed to be characteristic of this engine, that it possesses great stability in the adjustments by which the cut-off is made to take place at the same distance from the beginning of both strokes. The variations of the point of cut-off required for regulation being effected by variations in the advance of the eccentric which moves the cut-off valve, must necessarily be equal for both strokes, hence when it is equalized for the average position, as is the practice with the makers, it will be practically equal at all other positions within any required working range. Also, the cut-off being effected by the passage of the cut-off valve over the port when at nearly the fastest part of a travel of from 2 to 5 inches, according to size, it is not sensibly affected by a degree of misadjustment, which would in some cases almost entirely defeat the operation of releasing cut-off gear. The truth of this statement will, we think, be obvious to any unbiased person who understands that, in the class of engines alluded to, the accuracy of the cut-off adjustment depends on the accuracy of the movement of release.

Fig. 3.—Maximum Load for Best Economy.

Summarizing our remarks upon this engine, we may state briefly that it embraces radical improve-

ments upon the Buckeye system of valve gear. The makers have spared no pains to perfect its details; its workmanship is of the very best; and they claim that in respect to durability and simplicity, perfection of adjustments, compensation for wear on all parts, economy of space and of fuel, adaptability to any reasonable speed, great regularity of action, and wide range of power, the Hartford automatic cut-off engine will bear favorable comparison with the most approved forms of modern steam engines.

The Hartford Engineering Co. has only been organized for about a year and a half, but in this brief period has met with very pronounced success. The works are very conveniently and advantageously located adjacent to the Valley Railroad tracks and near the steamboat docks. The buildings consist of a foundry 65×227 feet, with half as much more space

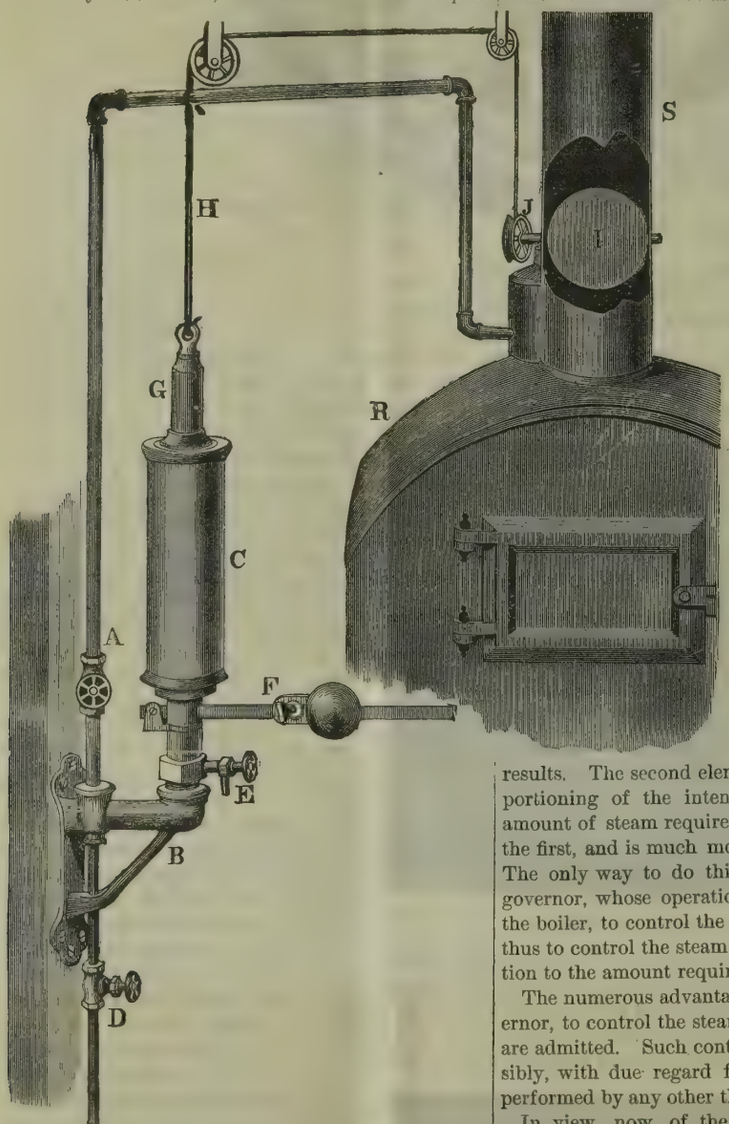


Fig. 1.—Arrangement of Damper Regulator.

in store-room, a machine shop 50×314 feet, a blacksmith shop 50×38 feet, and erecting-room 40×170 feet, a large pattern-room, a pulley shop 36×120 feet, a large number of storage and minor buildings, and a large boiler shop, which is now leased to other parties. The equipment of the establishment is very complete, embracing machine tools from the best makers, and of the largest capacity.

FLOODING THE SAHARA.—The French Cabinet Council has approved the scheme of M. de Lesseps for cutting a canal through the neck of land dividing the Gulf of Gabes from the salt marshes and low-lying parts of the Desert of Sahara to the South of Tunis. It is expected that the sea will, in virtue of this cutting, once more fill up the Sahara. The political advantage to be obtained by the scheme will be the insulation of Tunis and Algeria by creating a water barrier between them and Tripoli. The cost of the canal it is estimated will be 65,000,000 francs.

A New Damper Regulator.

While much stress is laid upon the proper setting of a steam boiler and the proper proportioning of its parts and accessories, in the effort to obtain as large a useful effect as possible from the fuel consumed, there are other considerations which are equally important in the economical generation of steam that are practically overlooked. To obtain the best results on the score of economy from the steam boiler, besides the above-named attention to general features of construction, several other elements are of prime importance. First, as regards combustion of the fuel. This should be as regular as it is possible to make it, and as nearly perfect as practicable; and its rapidity, representing the amount of fuel consumed, should be as accurately as possible proportioned to the amount of steam required in the service for which the boiler is employed.

The first of these elements of economy is provided for measurably by the judicious selection of a boiler adapted for the duty required of it, and by setting it in such a manner as will permit the entrance of air in such places, manner and quantity as to allow of its intimate commingling and combination with the gases liberated from the fuel, and thus insure a free and complete combustion. While some settings do accomplish much in this direction, few or none permit of obtaining the highest attainable results. The second element (that is, the proper proportioning of the intensity of combustion to the amount of steam required) is no less important than the first, and is much more difficult to provide for. The only way to do this, is to place an automatic governor, whose operations may be relied on, upon the boiler, to control the activity of the furnace, and thus to control the steam supply in accurate proportion to the amount required.

The numerous advantages of the steam engine governor, to control the steam admission automatically, are admitted. Such control as it gives could not possibly, with due regard for safety and economy, be performed by any other than automatic methods.

In view, now, of the well known fact that the largest percentage of loss in the use of steam as a motor, is laid to the charge of the boiler, it will surely require no argument to establish the fact that it is quite as important that the *generation* of steam should be automatically regulated in precise accordance with the demand, as it is to automatically regulate the steam *admission* to the engine.

But in four cases out of five, and perhaps in a greater proportion, the engine governor is saddled with the extra work of atoning for the irregularities and shortcomings of boiler regulation. The draft, left to the attention of the fireman, is left undiminished as the steam pressure rises; steam is blown off and wasted before the damper is turned, and continues to blow off for some time, until the intensity of combustion diminishes. Meantime the engine governor (as if it had not enough to do, to throttle more closely, or to cut off earlier, whenever a machine is thrown off, or is eased of its work) is compelled to further cramp the admission, or to cut off still earlier, on account of increased and unnecessary steam pressure. That such practice is imperfect and wasteful is apparent. When the boiler pressure runs down, it may happen that the work required of the engine is at its maximum; perhaps live steam is required for heating or for other purposes; but the engine governor, while it can cram or cut off the steam supply, cannot open the damper. The loss and waste from this element of faulty operation is often increased by the loss of materials injured by waiting for steam or power which fail at the time they are imperatively required. It will hardly be necessary to continue the enumeration of the evils necessarily attendant upon this source of trouble. The moral is evident—the boiler must have a governor of its own to regulate the air supply to the furnace, and consequently to control the intensity of combustion, in direct proportion to the steam demand, and keep the steam at

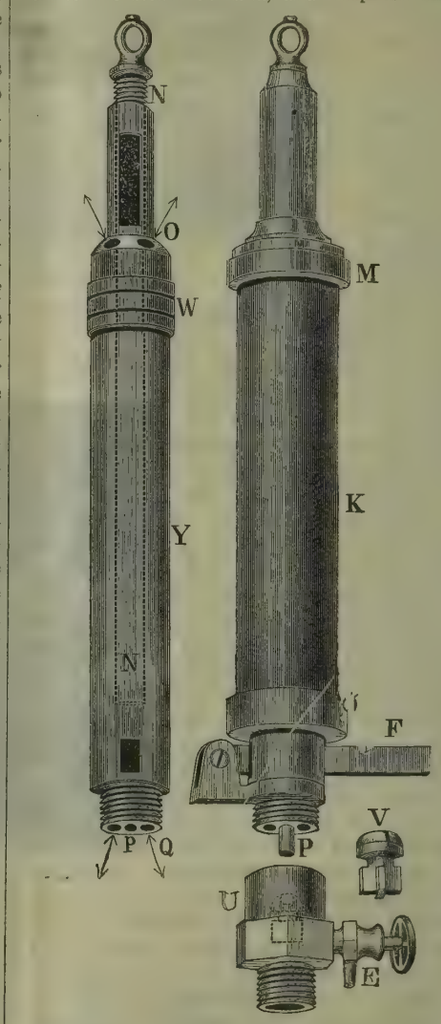


Fig. 2.—Details of Damper Regulator.

about a constant pressure, and thus aid the engine governor in the work of economy.

The regulator described in the following comes to us with many favorable notices. It has the merit of being exceedingly sensitive, a feature of great importance in this class of apparatus—so much so that the weight of an ordinary handkerchief thrown over the lever will cause a noticeable movement of the damper; the purpose of the inventor having been to provide a damper regulator that should hold the damper in proper adjustment to correspond to the steam pressure required. Its construction and operation are described as follows: In Fig. 1 the general arrangement of the regulator is shown as connected with the damper. As here represented it is attached to the wall by means of a bracket B, the steam for operating being taken through the pipe A. The drip pipe D is to carry off the condensed water from the pipe A, and the pet cock E is to drain the water from the body of the regulator. Referring to Fig. 2, it will

be seen that the apparatus consists of a piston Y, upon which works an accurately fitted cylinder K, which is in turn covered by a cap C, Fig. 1. To the bottom of the piston is screwed the section U, in which is fitted the valve V. Upon this valve rests the stem P, the top of this stem bearing against the weighted

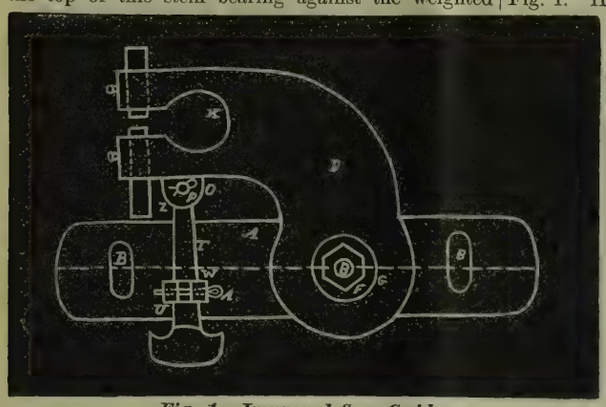


Fig. 1.—Improved Saw Guide.

lever F. The operation is as follows: The weight (which weighs only from 1¼ to 2½ pounds) is adjusted on the lever F, so that the valve will open at the pressure which it is desired to carry on the boiler, when the steam entering through the ports Q and passing out at the ports O, raises the cylinder, if necessary, till a projection at L comes in contact with the bottom joint W, at which time the damper is entirely closed, through the means clearly shown in Fig. 1. The steam is prevented from passing down the ports O by the ground joint W. The dotted lines at N represent a guide which keeps the ground joints parallel during the movement of the cylinder. As soon as the boiler pressure falls sensibly below that determined upon, the weighted lever seats the valve, cutting off the supply of steam, and the condensation passing out of valve E, permits the weight of the cylinder and cover to open the damper.

Anti-corrosive metal has been employed in its construction, to insure greater effectiveness and durability, and to lessen friction; while the use of steam as the actuating medium is claimed to be advantageous in obviating the objections of unequal expansion and contraction which are met with in devices employing water for this purpose. The device is very compact, taking up little space, and may be attached in any position that may be most convenient from which it may be used to operate several dampers within reasonable distances.

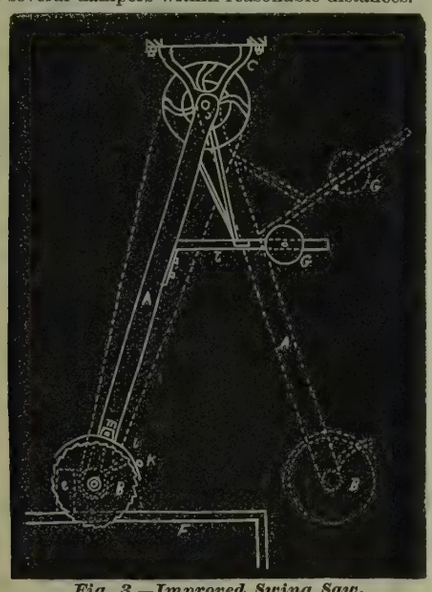


Fig. 3.—Improved Swing Saw.

Further information concerning this useful and ingenious appliance may be obtained by addressing Mr. Frank A. Hine, 81 Maiden Lane, New York, who will supply such details as we have overlooked.

Recent Improvements in Wood-Working Machinery.

John P. Hall, of Bluffton, Ind., has invented the following improvement in saw guides, shown in Fig. 1. He provides a base plate A, which is cast with a projecting frustrum-shaped boss, on which the lever D is pivoted. At the forked end of the lever is provided the lug O, in combination with which is a screw nut, which may be operated in connection with the screw shaft T.

Fig. 2 is a representation of an improvement in saw sharpening machines, devised by William H. Halliday, of Chicago. This invention comprises essentially a grinding wheel F, combined with certain operating and adjusting supports placed below the axis of the saw. A tilting frame is provided in combination with a continuous cam L, and an oscillating support for giving to the wheel F a diagonal position. In connection with these parts feeding devices are provided for bringing the saw teeth to the wheel F.

Fig. 3 represents an improvement in the construction of a swing saw, devised by John Connell and V. Dengler, of Rochester, N. Y. The invention consists substantially of a swinging frame A, which is

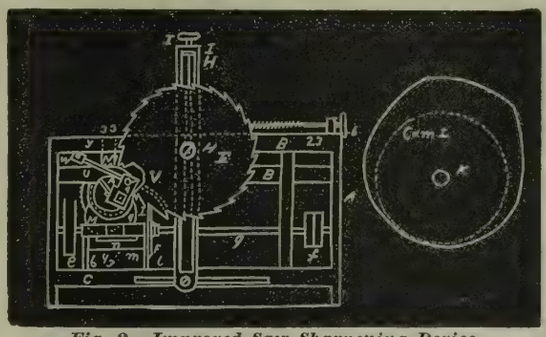


Fig. 2.—Improved Saw Sharpening Device.

pivoted vertically over the table F which supports the work, and which is on the line of the driving shaft. The frame is provided with the saw B, which is driven from the shaft by the belt *a*. In connection with the above is an arm *t* projecting laterally from the frame A, and provided with the weight G.

An improvement in cutter heads for wood-working machines, invented by John C. Tunnicliff, of Galesburg, Ill., is shown in Fig. 4. The inventor claims in a cutter head, in combination with grooved head stocks C C, the gauge collar D, having a thicker portion, or projection, provided with grooves in which the cutters are seated, and may be adjusted lengthwise, and held after adjustment by the head stocks with all parts of their cutting edges projecting beyond the thicker portion of the gauge collar, to give clearance to the cutters.

Fig. 5 represents an improvement in wood-turning lathes, devised by Chas. W. Wilder, of Fitchburg, Mass. In this device the tool carriage has an interchangeable ring rest, through which the stick passes, provided with a roughing tool which is pivoted to a vertically adjustable arm *f*, and which is itself vertically adjustable for the purpose of causing it to bear on the ring. The special features of the invention will be best understood from the principal claims of the inventor, viz.: In a lathe of the character described, a tool holder connected to the wrist pin of a crank wheel, the hub of which turns about a bearing

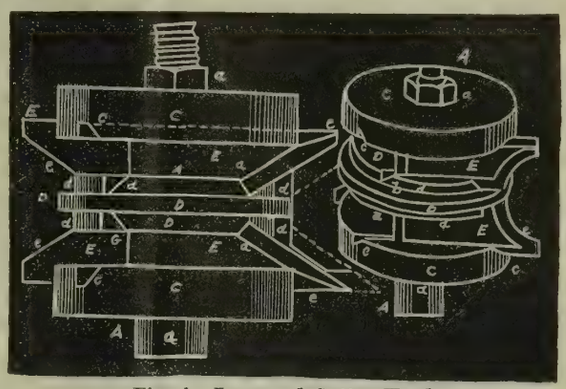


Fig. 4.—Improved Cutter Head.

depending from the tool carriage, in combination with a retracting spring, an actuating lever, and a flexible connection between the crank wheel and lever. The combination, in a lathe, of a movable tool carriage, a movable finishing tool, a knee lever, a crank wheel, a flexible connection between the knee lever and crank wheel which allows an unvarying leverage and an instantaneous release of the tool from the finished work, and means for retracting the tool when the knee lever is released. The combination in a lathe of the character described, of the holder of the finishing tool, the arm rigid thereon and the holder of the cutting-off tool, having right angular intersecting grooves therein, and the binding screw for confining the tool and its holder to said arm.

Shield for Circular Saws.

A new self-acting safety shield for circular saws, designed to guard against the constant danger which threatens the workmen, is made of a plate of iron or steel about as thick as the saw, curved to its radius, and broad enough to give sufficient firmness. It is placed at a given distance from the teeth of the saw, and is furnished with movable plates and adjustment slides and screws to suit the alterations in the diameter of the saw by wear, or the substitution of smaller for larger saws, or stuff deeper than the cutting part of the saw. The shield is attached to an arm hung upon a stud concentric with the saw mandrel, and is balanced by a counterpoise under the table. The semicircular shield is about one and a half inches deep and the same thickness as the saw. The forward end is so formed that the piece of timber to be cut raises the shield, but the latter rests upon the timber and forms a guard which prevents the workman from bringing his hands or arms into contact with the cutting edge of the saw;

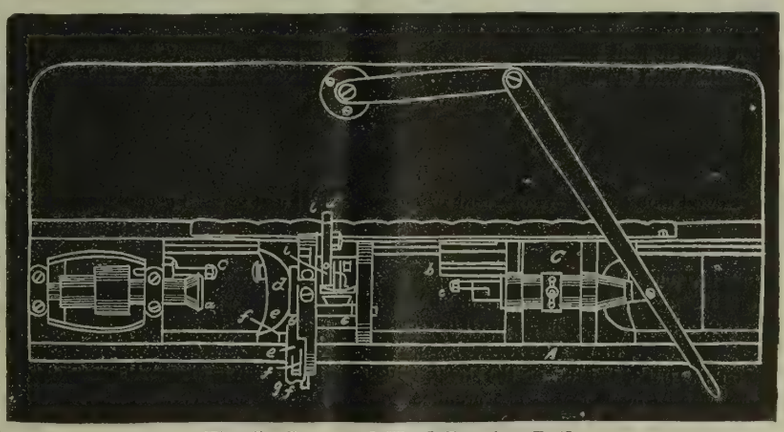


Fig. 5.—Improved Wood-Turning Lathe.

as soon as the timber has passed from the saw the shield returns to its original position, entirely covering the saw, and so remains until raised by the next piece of timber.

Building Intelligence.

Architects, Builders and Contractors are invited to send us items of interest for this department. It is our object to notice only the more important operations in building, our space being too limited for the publication of minor matters, which, besides, possess only local interest. We wish to publish only such intelligence as is of general interest.

New York City Building Items.

The Broadway Tabernacle Society has filed plans for a church edifice to be erected at 455, 457 and 459 Tenth avenue, the dimensions of the building to be 74 feet front by 100 feet deep.

Park & Tilford are to have a store built on Fifth avenue, a little below Sixtieth street. It will cover a lot 50 by 100 feet, and is to cost not less than $100,000. D. & J. Jardine are the architects.

A Workingman's School and Free Kindergarten building is being erected on West Fifty-fourth street, near Sixth avenue, by the Society of Ethical Culture, of which Prof. Felix Adler is the central figure.

Oliver H. Keep has filed plans for the erection of a shirt manufactory at 640 Broadway, on the southeast corner of Bleecker street, to run through to Crosby street, to be six stories high, and to cost $90,000.

Norman L. Munro is erecting an eight-story Philadelphia brick and granite publishing house at Nos. 24 and 26 Vandewater street. It will be 50 by 93 feet, and will cost $65,000. The architect is J. Morgan Slade.

An edifice for the Calvary Baptist Church is being erected at Sixth avenue and Fifty-seventh street. The building will be of Lockport granite, trimmed with Berea stone, 100 by 160 feet. J. R. Thomas is the architect, and Thomas F. Treacy the builder. It will cost $200,000.

On the southwest corner of Tenth street and avenue A, a one-story brick church and three-story school and library building is to be erected at a cost of $100,000. The owner is Rutherford Stuyvesant. The architects are J. Renwick and Wm. H. Russell, and the builders Peter T. O'Brien & Son.

Wilhelm Pickhardt, of 735 Madison avenue, has filed plans for the erection of a private residence on the southeast corner of Fifth avenue and Seventy-fourth street. The house is to be four stories high, fire-proof, and built of brick, iron and brown sandstone. Its cost, when finished, will be $250,000.

A very elegant apartment house is soon to be erected on the west side of the city. The site selected for this improvement is the plot of ground on the northwest corner of Ninth avenue and Seventy-eighth street, 100 by 102 feet. The plans have been drawn by Emil Gruwe. It is expected that a Russian bath and a safe deposit company will be established in connection with the apartment house.

The Knickerbocker Apartment Company have purchased the Knickerbocker Club House, and propose to erect upon its site an apartment house of the first-class at a cost of about $1,000,000. The building is to extend along Fifth avenue, and two other buildings adjoining the club house on Fifth avenue, below Twenty-eighth street, have been purchased and will be razed to make way for the new structure.

James Campbell is about to build, at an expense of $300,000, a large family hotel at Gramercy Park and Twentieth street, to be nine stories high, fronting 63 feet on the park, 125 feet on the street, with an L in in the rear 27 by 44 feet. The architecture will be Renaissance in style, with three open courts. The first two stories will be of stone, and the rest of brick with terra-cotta trimmings. The designs for the hotel have already been drawn.

A coöperative apartment house now building at the corner of Fifty-second street and Madison avenue will have several special features. The basement will be almost entirely above the sidewalk; there will be a fire-proof mansard roof, on which a summer garden will be arranged, with a fountain and sprinklers to keep the tiles cool; marble stairways, an appliance for cremating vegetable refuse, and all the rooms to be heated by air warmed by steam pipes. A novel improvement is to be put in the bedrooms; instead of slats the bedsteads are to have bottoms of steam pipes, which will be connected with a steam coil for warming purposes. The building is to cost $350,000, and will be ready for occupation in October next.

Plans have been drawn for a large coöperative apartment house to be built on the southeast corner of Fifth avenue and Twenty-eighth street, fronting 121 feet on Twenty-eighth street and 87 feet on the avenue. It is to be built of brick, Belleville stone and terra-cotta, will be eleven stories high and fire-proof throughout. It will accommodate twenty-three families, and is arranged so that parlors and dining-rooms will be two stories. The interior finish will be ebony, mahogany, etc. Servants' rooms, offices, etc., look out into a yard. The first floor is to be used for a safe deposit company and stores. There will be four elevators. The cost will be about $450,000. Chas. W. Clinton is the architect.

William V. A. Mulhallon is about to erect a first-class eight-story apartment house in the Venetian style on the north side of Seventy-second street, 100 feet east of the Boulevard, 90 by 90 by 102 feet 2 inches. It will be of pressed brick, richly trimmed with brown stone. The entrance will be by a twin stoop, in the center of which will be a large and handsome bronze urn containing a century plant. The main corridor will be T-shaped, 16 by 32 feet, and in the center of which will be a fountain of unique design. On the ground floor there will be reading and reception rooms, as well as the office. The first floor will contain two flats, each of eight rooms and a bath-room. The upper stories will have four suites of seven rooms and bath-room. There will be two elevators, 5 by 9 feet each. Every room will have direct ventilation and light—in fact, this structure will be one of the finest of its character yet erected in this city. W. H. Cauvet is now preparing the designs, and estimates the cost at $125,000.

W. H. Cauvet is engaged on the designs for a magnificent four-story brick and brown stone private dwelling for William Van Antwerp, to be erected on the northeast corner of Fifth avenue and Seventy-fourth street. It will be in the English baronial style, 24 by 85 feet, and the front will be very elaborately carved in chaste designs, all the work being done by hand. The first floor will contain a drawing-room, dining-room, conservatory and Mezannine butler's pantry. The main hall will be 16 feet square, and very handsome, while the conservatory will be furnished with costly cathedral glass windows. The interior of the house will be finished throughout in very elaborate cabinet style in rosewood, mahogany, oak and ebony. The chambers will each be connected with a private bath and dressing-room. The roof, which will be capped by slate towers of unique design, will be fire-proof. The cornices will be all of heavy 22-ounce copper, bolted with iron. There will be both passenger and baggage elevators. It is estimated that the cost of the erection of this magnificent residence will be $120,000. It is the intention of the owner to occupy this dwelling upon its completion.

Robert and Ogden Goelet are to build a hotel on northeast corner of Broadway and Forty-third street, which is to cost about $800,000. It will have a frontage on Broadway of 76½ feet, and its depth will be 85½ feet. The structure will be eight stories in hight and thoroughly fire-proof. The architecture will be of the simplest type, and the materials to be used in the construction of the building are Philadelphia brick, with terra-cotta and Belleville stone trimmings. The first floor will be devoted to offices, reading and reception rooms and a restaurant. Dining-rooms and nurseries are to occupy the second floor, and suites of two rooms each will complete the accommodations of the building. The first floor is to be finished in hard woods—ash and bay woods, with walnut or maple moldings. The staircases are to be built entirely of iron and stone, and the elevators are to be inclosed by fire-proof shafts. Heavy cast-iron columns will support the front of the building, and will rest on a cement and quarried-stone foundation. The ground was broken on May 18th, and it is expected that the hotel will be finished in May, 1883. It is to be called the Barrett House, and the lessees and proprietors will, it is supposed, be William C. and Hooper C. Barrett.

Miscellaneous.

A new building for the Newsboys' Home, at No. 61 Poplar street, Brooklyn, N. Y., is to be put up at a cost of $43,000.

Tarkis, Atchison county, Mo., is to have a court house of brick, two stories high, 90 feet square, and to cost $30,000.

The Chicago, Milwaukee & St. Paul Railway Company will soon commence the erection of an elegant depot building in Madison, Wis.

The Haverhill, Mass., burned district is a busy scene. Twenty-five blocks, embracing over forty front stores and rear buildings for manufacturing, are rapidly advancing to completion.

At Rochester, N. Y., contracts have just been awarded for the Powers Hotel, which will be the largest hotel in that city. W. H. Gorsline is the mason, Robert Boyd the carpenter, and Warren & Brackett the architects.

The Washington Ice Company, of Chicago, is erecting a house on the east side of the river, at Elgin, Ill., that is to have a capacity for 24,000 tons of ice. Its dimensions will be about 200 by 270 feet, and 30 feet high.

A new edifice is to be built for the Holy Trinity German Roman Catholic Church, at Montrose and Graham avenues, Brooklyn, N. Y. The dimensions are 88 by 170 feet. Two towers will rise to the hight of 220 feet. It will cost $200,000.

Horace G. Knapp is the architect of the building for the New York State House of Refuge for Women. The building will be erected at Hudson, and will be in the Gothic style. It will be four stories high, built of brick with stone trimmings, will have a slate roof, and be fire-proof. The cost will be $100,000.

Ross R. Winans is erecting a magnificent residence in Baltimore, Md., which is said to be the finest private house south of New York. The lot upon which the house stands is 125 feet front by 122½ feet deep. The house itself is 66 feet front by 75 feet deep, and it is to be five stories high, with sloping mansard roof. The style is French Renaissance, and the exterior, when completed, will resemble very closely an old Belgian or French chateau. The interior of the residence is to be as grand as the fancy of the owner can make it. It is to be of satin, red oak and ebonized cherry woods, inlaid and carved, and in each room there are to be costly beveled mirrors. The hall will run the full length of the building, and upon its ornamentation and decoration are to be expended alone $50,000. The cost of the entire building and garden will not be less than $200,000. There are rooms in the basement for sixteen servants; also a laundry, kitchen, boiler-pit, store-room and drying-room. On the first floor there is to be a handsome ball-room, drawing, reception and dining rooms, parlor and library. The other floors are to be taken up with bedrooms. The most striking features in the architectural appearance of the house are two towers, one at the front and the other at the rear. At the side of each of the towers rise four circular chimneys, unique in design and made of red pressed brick, with jet black cement, all combined in one. The material of which the house is built is pressed brick and Long Meadow brown stone, and the blending of color is rich and perfect. Building operations were begun this spring and the house will be finished about November

The Cushing Hydraulic Elevator.

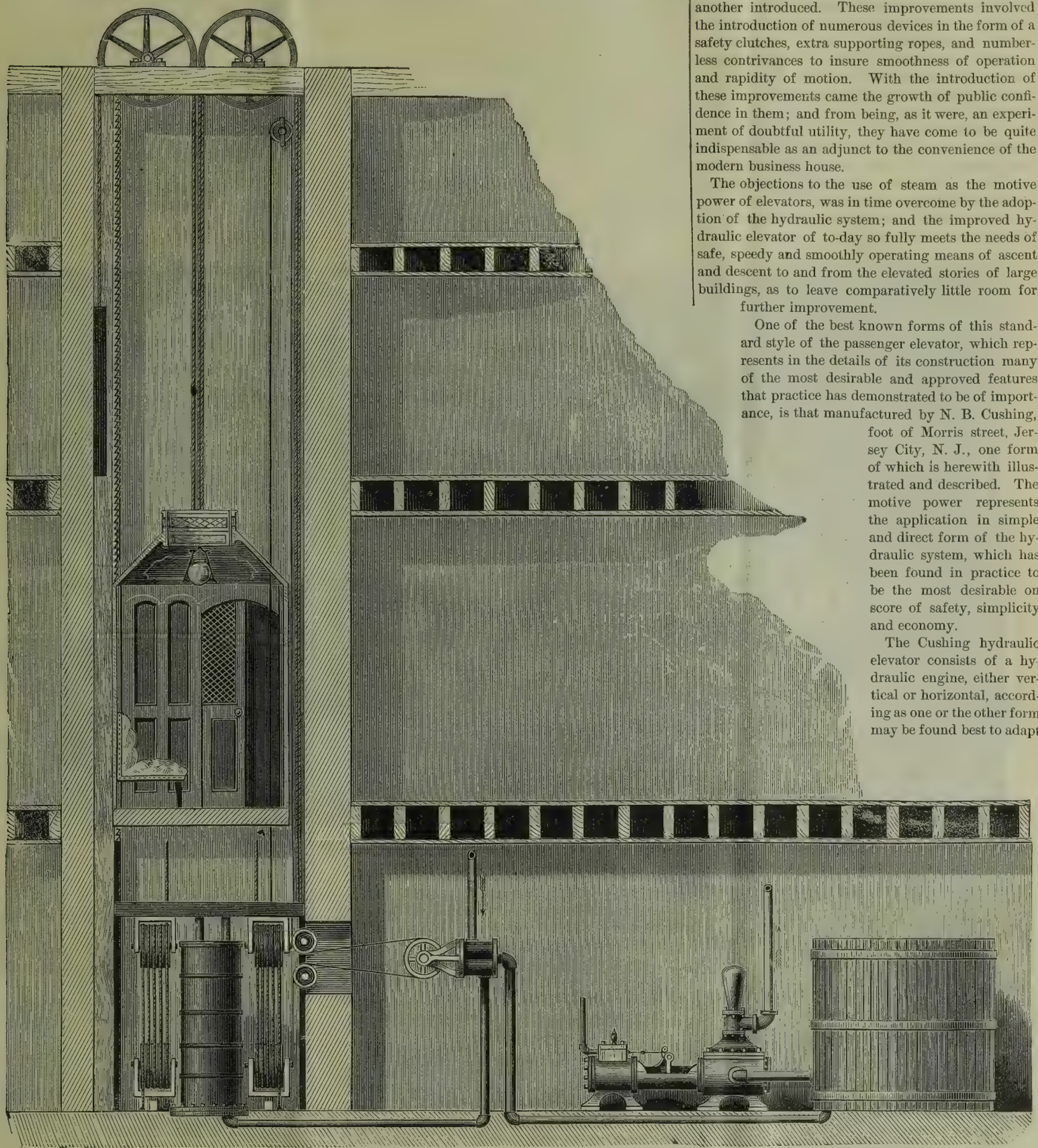
There is no special service in which the ingenuity of the mechanic is subjected to greater demands than in that of supplying the needs of practice in the construction of passenger elevators. There are but few of our readers who will not recall the fact of the vast improvement in the design and construction of these devices that the exigencies of modern business and social life have made indispensable. So great has been the change in public sentiment respecting these devices, and so largely has the business of manufacturing them grown to be, that their production has become one of the acknowledged and important branches of the mechanical industries, demanding specially trained mechanical skill and a high degree of accuracy and ingenuity on the part of makers.

The old, crude freight cage of a couple of decades ago is the progenitor of the numerous varieties of smooth and rapid running passenger elevators, tasteful and elegant in their appointments, and as near to absolute safety in their operation as mechanical ingenuity can well devise. Many of our readers of mechanical taste have perhaps followed the development of the passenger elevator from its first crude and imperfect condition to its present highly perfected state. At first, the passenger elevator was simply a slight improvement upon the old freight cage, with certain modifications of a minor character to adapt it to its altered duties. Gradually, to establish pulic confidence in their safety, and to meet the demands of practice, the various mechanical improvements with which we are all familiar, were one after another introduced. These improvements involved the introduction of numerous devices in the form of a safety clutches, extra supporting ropes, and numberless contrivances to insure smoothness of operation and rapidity of motion. With the introduction of these improvements came the growth of public confidence in them; and from being, as it were, an experiment of doubtful utility, they have come to be quite indispensable as an adjunct to the convenience of the modern business house.

The objections to the use of steam as the motive power of elevators, was in time overcome by the adoption of the hydraulic system; and the improved hydraulic elevator of to-day so fully meets the needs of safe, speedy and smoothly operating means of ascent and descent to and from the elevated stories of large buildings, as to leave comparatively little room for further improvement.

One of the best known forms of this standard style of the passenger elevator, which represents in the details of its construction many of the most desirable and approved features that practice has demonstrated to be of importance, is that manufactured by N. B. Cushing, foot of Morris street, Jersey City, N. J., one form of which is herewith illustrated and described. The motive power represents the application in simple and direct form of the hydraulic system, which has been found in practice to be the most desirable on score of safety, simplicity and economy.

The Cushing hydraulic elevator consists of a hydraulic engine, either vertical or horizontal, according as one or the other form may be found best to adapt itself to the requirements of the situation in which it is to be introduced. In the illustration herewith given, the vertical form of the hydraulic engine is shown. It is provided in either form, with piston of proper diameter and stroke for the work required of it; a frame supporting the sheaves, and guides for the traveling head, the whole securely braced in position. The valve mechanism by which the water is alternately admitted to the cylinder or allowed to flow out



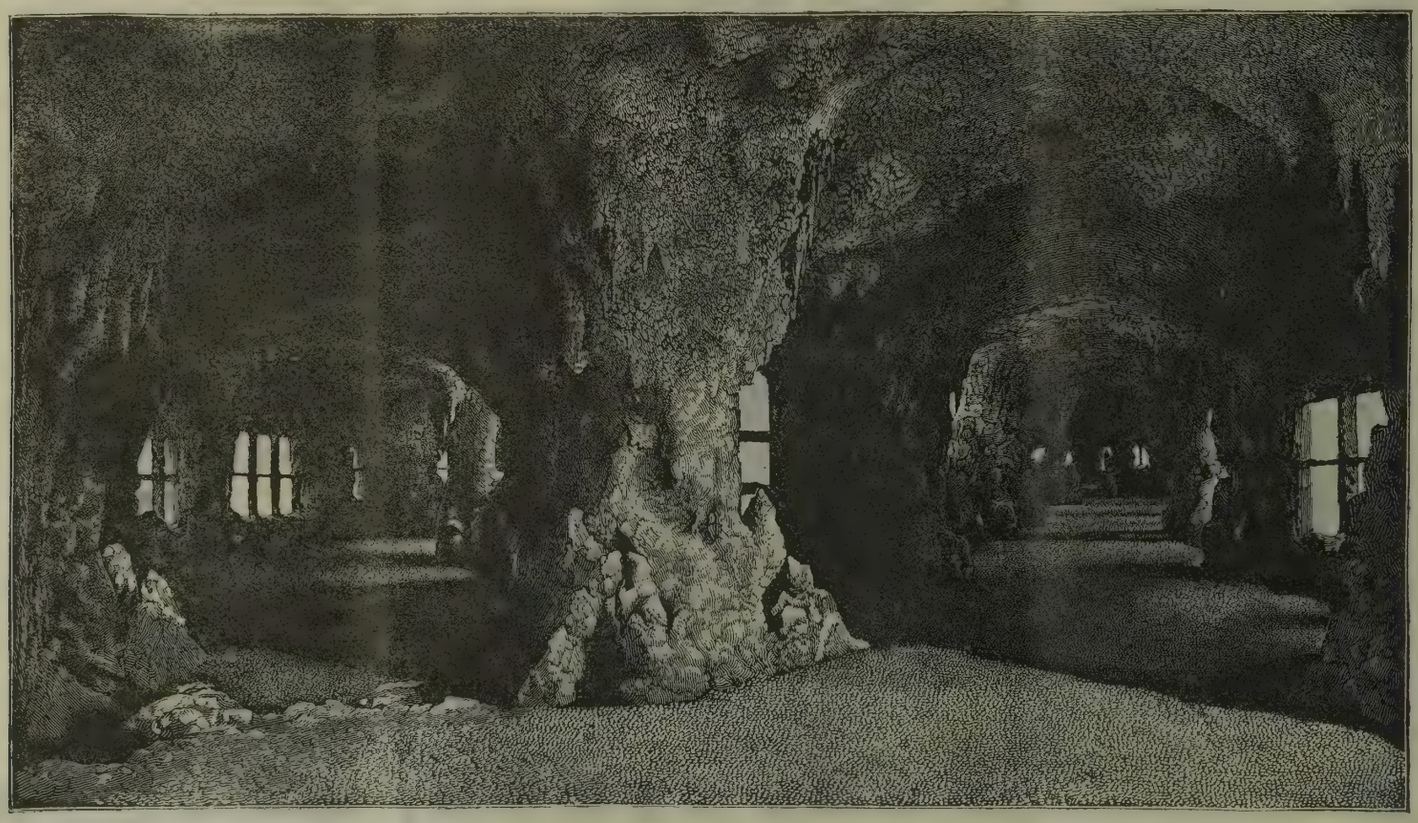
THE CUSHING HYDRAULIC ELEVATOR.

of it, according as the car is required to move up or down, is of simple construction, and is operated by a wire rope, seen in the engraving passing through the car. The other requirements of the system, are a tank at the top of the building and another in the basement, and, in situations where a city water supply may not be available, or may not afford water in sufficient quantity for the work, or where for economic reasons it may be found expedient to use it, a pump, for forcing the water from the lower tank to the upper one, so that the same water may be used over and over again.

Concerning the numerous minor details of this particular make of hydraulic elevators, we may refer here to the following brief extract from an earlier description of the form provided with the horizontal engine, which some of our readers may recall:

The carriage is suspended from a number of wire ropes passing over fixed pulleys placed above the highest point of the lift, and from those about the sheaves connected with the piston rod of the hydraulic engine. In addition to this, there is also a weighted block suspended from one of the overhead pulleys, which, with the resistance of the piston of the hydraulic engine, constitutes a counterpoise for the car. The additional safety appliances adopted in connection with the car, are as follows: The guide posts for the car extend throughout the whole hight of the building, from the cellar to the roof, and are faced with safety ratchets, between which the safety-car platform is raised and lowered by means of the two wire lifting ropes which are connected with the hydraulic engine. The car platform is fitted with safety locking pawls, combined with a powerful steel spring, and the simplest possible device for forcing the safety pawls into contact with the safety ratchets should the lifting ropes break. These have been used for many years, have proved perfectly reliable, and can be depended upon to reduce the possible fall of the car to the length of the ratchet tooth.

Besides the ordinary safety pawls attached to the lifting ropes, there is an extra set of patent safety pawls underneath the platform of the car, which are operated by a separate wire safety rope. This rope is a safety device entirely disconnected from any of the other working parts of the apparatus, and extends from the top to the bottom of the hoistway, running over pulleys at the top and bottom, and both ends are connected to the lever which operates the safety pawls under the car. The safety rope travels with and at the same speed as the car. In the upper part of the hoistway the rope passes over pulleys which give motion to a safety hammer or brake. When the car is running at its ordinary speed, the safety hammer does not act; but as soon as the speed is accelerated beyond what it should be, balls fly out and strike a catch-plate, the brake is dropped, and the motion of the safety rope ceases, while the motion of the car is continued far enough to throw the safety pawls or dogs into the safety ratchets, and the car stops instantly. In addition to the above-mentioned safety devices, there is also an automatic stop upon the hydraulic engine, so that if the check rope should break and the operator lose control of the car, the engine will stop itself when the car arrives at the top or bottom of its run. We may add in conclusion, that on the score of safety, smoothness of operation, non-liability to derangement, and economy of operation, the maker of this system of hydraulic elevators claims for them all the advantages which are claimed for the best and most approved styles of this class of machines now in use. Such information as our limited space requires us to omit in this brief account, may be had of the manufacturer, whose address is given above.



GROTTO AND AQUARIUM OF THE TROCADERO.

A New Mechanical Dictionary.

The publishers of "Knight's American Mechanical Dictionary," Messrs. Houghton, Mifflin & Co., of Boston, have favored us with the announcement that they have arranged for the early publication of a supplementary volume to this standard work, which shall embrace all of the important advances that have been made in the mechanic arts and applied sciences bearing thereon since the period of the original publication. Those who are familiar with the progress of the mechanic arts, need not be told that in many respects the advance made within the past few years has been phenomenal and unprecedented in the history of the world. Not only have we had the surprising introduction of the telephone, and the great improvements in everything relating to the important subject of electric lighting since the appearance of the dictionary, but since then we have had two great world's fairs, with both of which the author was prominently identified as a member of the jury, and numerous and important developments in every department of applied mechanics.

The necessity for incorporating the important developments of the past few years into the great work with which Mr. Knight's name is identified, has induced the publishers to issue an entirely new volume, thus continuing the record from the date at which the former work went to press, but carefully avoiding repetitions, and aiming, as they explain, "to furnish not only a satisfactory supplement to the original work, but a book which shall have an individual and separate value as a complete record of half a decade in the history of inventions."

The same method of arrangement, alphabetically by subjects, which rendered the original so convenient for reference, will be followed in the new one; and special features of improvement in the form of specific indexes are announced to increase its convenience. One very important feature, which we think is a most admirable one, will be the publication, with each subject, of a complete list of every article which has appeared during the years 1876–1880 in the columns of the foreign and American technical journals. As every contribution of importance bearing upon the subjects treated of has been very fully discussed in these journals, the new work will put at the disposal of the reader the complete bibliography of these subjects for the period named, a feature of inestimable value to the student and investigator, and one which will be duly appreciated.

Advance sheets which have been kindly transmitted by the publishers for our inspection, fully sustain the eminent claims put forth in the announcement of the new work. We give in connection with this notice a sample illustration, to show their general excellent character. It represents the Grotto and Aquarium of the Trocadéro, which will be recalled by all visitors to Paris in 1878, as one of the unique and most interesting features of that exhibition. The work will be completed in four sections of 240 pages each, and will cost $2 per section. Section one is now ready. The entire work will be completed during the present year.

Explosion of Two Steam Boilers.

The subject of our illustrations is the explosion of two large steam boilers, on February 16, 1882, at the Jewell Flouring Mill, in Brooklyn, N. Y. This double explosion caused the death of Levi J. Stevens, the engineer, injury to a number of persons, and the destruction of the boiler house and portions of the main building and chimney, as shown in Fig. 1.

These boilers were of the horizontal, internally-fired type, known as drop flue boilers. They were 7 feet in diameter and 21 feet long, shells of iron plates, single riveted, originally called five-sixteenths of an inch thick.

The two exploded boilers had seven courses of plates in the shell—three plates in each course.

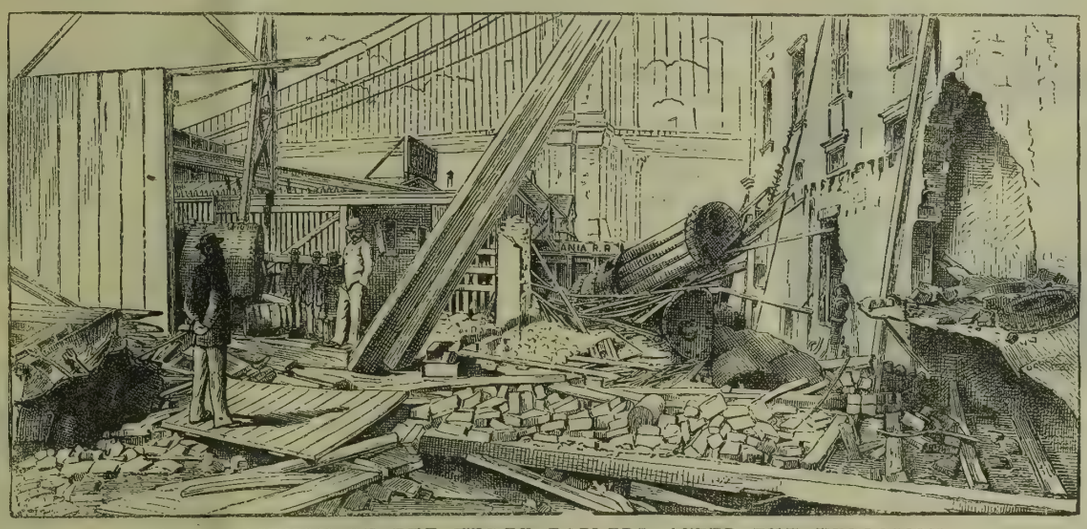


Fig. 1.—POSITION OF THE THREE BOILERS AFTER THE EXPLOSION.

The third boiler, which did not explode, but was thrown about 50 feet out of its bed, was of the same size, but of weaker construction, on account of the larger exit flue in the shell.

A few minutes before noon, on February 16, while the engine was running at the usual speed, the steam gauge indicating 47 pounds pressure, and the water gauges showing the usual amount of water, and while the engineer was standing immediately in front of boilers, the middle one exploded, and the shell was nearly all stripped off. The remainder of the boiler was thrown high in the air, probably made several somersaults in the air, and brought down beneath it in its fall a corn conveyor which passed above the boiler house roof, and entered the main building about 30 feet above the boiler site. The shaft and worm of this conveyor lay beneath No. 2 boiler, as shown in Fig. 1, proof that the boiler rose higher in the air than the position of the shaft and worm.

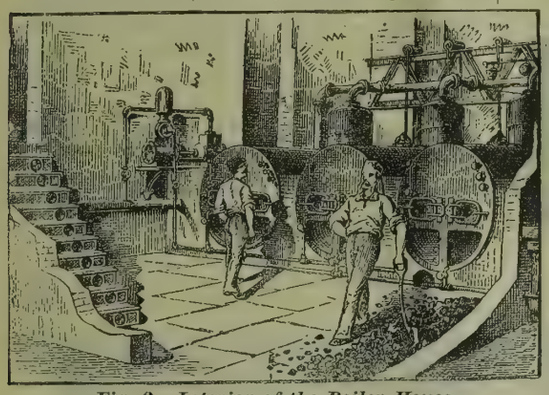


Fig. 2.—Interior of the Boiler House.

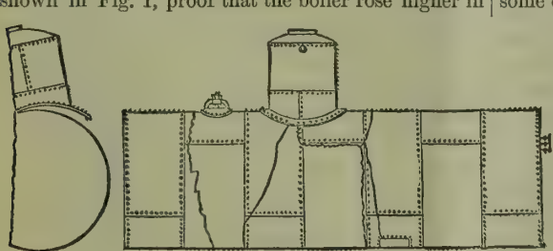


Fig. 3.—Showing Initial Rupture.

During the period of time that this boiler was in the air, No. 1, the left-hand boiler, having been forcibly struck by parts of No. 2, also broke open, but on such a line of initial fracture that its main portion was projected horizontally to the front, arriving at the front wall of the building in time to fall under No. 2, as shown in Fig. 1. There can hardly be a question about the direction taken by these two boilers. The most probable hypothesis is indicated in Fig. 3, inasmuch as the rupture separates a ring of plates which was found folded together beneath the pile of *débris*. If the initial break had been at some point on the bottom, then this belt of plates would have been thrown upward and flattened, instead of downward, where it was folded by the flood of water from No. 1 boiler.

The third boiler was hoisted out of its bed by the issuing water, and thrown about 50 feet to the right of its proper place.

These two boilers contained probably more than 14 tons of water, which had a temperature due to 47 pounds pressure, and the effect of its sudden liberation equal to that of several hundred pounds of burning gunpowder.

The most reasonable hypothesis is that the middle boiler broke first at the calking edge of the longitudinal seam, Fig. 3, this line having been gradually weakening.

Second, the iron was brittle, although its tensile strength may have been satisfactory—said to have been 45,000 or more.

These boilers had been inspected by the Hartford Steam Boiler Inspection and Insurance Company, and the company has been made the target for some very severe newspaper criticism since the occurrence of the explosion. We are not disposed to join in the general denunciation which often follows occurrences of this character, the only cause for which is too often the necessity of finding some convenient scapegoat to bear the burden of the offense. We are, in common with many of our readers, too well acquainted with the careful methods of the Hartford company to entertain for a moment the belief that its officers would be willfully careless or take unnecessarily hazardous risks. The whole course of the company's history gives an emphatic denial to any such suggestion, and the record which it has made during the many years of its existence will furnish the doubtful with ample evidence to demonstrate these statements.

From a careful reading of the evidence brought out in the public discussion of this notable case, we think it safe to affirm that there were conditions involved, which, if properly understood, and the proper weight had been attached to them, would go far to modify the general verdict as to the responsibility for this occurrence. Some of these are hinted at in the following: It may be asserted, from an examination of the parts of the exploded boilers, that the incipient rupture was not at the theoretical weakest point. It did not commence at or along the longitudinal seam, but began at the drop connection, and followed along at the girth or "round-about" seam. The boilers were supported from a girder in the rear, and rested on a wall or foundation in front. The peculiarity of the fracture indicated the presence of some strain other than that caused by internal pressure. The settling of the foundations has been suggested, and in studying the locations and surroundings, there appears to be good grounds for such an opinion. The buildings are located on a dock of "made ground," driven thick with piles so as to secure a foundation. The chimney settled some time ago, and it became necessary to fasten it to the walls of the building by iron rods or straps, to hold it in position. The foundations of the engine have settled once or more, and it has been necessary to relay or readjust them. The boilers were located outside the main building, and nearer

Fig. 4.—Explosion of the Boilers.

the water's edge than either the chimney or engine. Now, a slight settlement of the foundations of the support at either end would cause a strain that might ultimately result in fracture, and the rupture, once started, the rest is easily accounted for. It might be said that the settling of the chimney and engine foundations should have called the inspector's attention to the boiler foundations. But those familiar with the business can readily see that it would be no easy defect to discover, and the influence of heavy rains and high tides may have been an important element in the problem. In forming a conclusion, these and other probabilities should be duly considered.

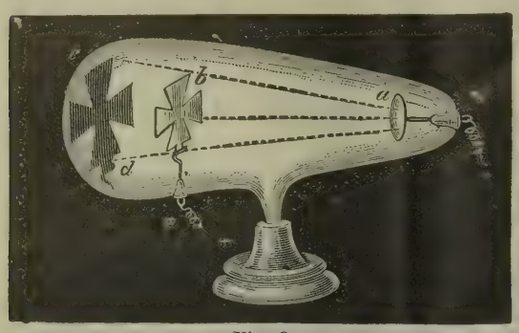


Fig. 9.

Radiant Matter.

[*Continued from page* 132, *June Number*.]

Radiant Matter when Intercepted by Solid Matter Casts a Shadow.—Radiant matter comes from the pole in straight lines, and does not merely permeate all the parts of the tube and fill it with light, as would be the case were the exhaustion less good. Where there is nothing in the way, the rays strike the screen and produce phosphorescence, and where solid matter intervenes they are obstructed by it, and a shadow is thrown on the screen. In the pear-shaped bulb (Fig. 9) the negative pole *a* is at the pointed end. In the middle is a cross *b* cut out of sheet aluminum, so that the rays from the negative pole projected along the tube will be partly intercepted by the aluminum cross, and will project an image of it on the hemispherical end of the tube, which is phosphorescent. By turning the coil, a black shadow of the cross will be seen on the luminous end of the bulb *c d*. Now, the radiant matter from the negative pole has been passing the side of the aluminum cross to produce the shadow; the glass has been hammered and bombarded till it is appreciably warm, and at the same time another effect has been produced on the glass—its sensibility has been deadened. The glass has got tired, if the expression may be used, by the enforced phosphorescence. A change has been produced by this molecular bombardment which will prevent the glass from responding easily to additional excitement; but the part that the shadow has fallen on is not tired; it has not been phosphorescing at all, and is perfectly fresh, therefore if the cross is thrown down—which can easily be done by giving the apparatus a slight jerk, for it has been most ingeniously constructed with a hinge—and so allow the rays from the negative pole to fall uninterruptedly on to the end of the bulb, the black cross *c d*, Fig. 10, will suddenly change to a luminous one *e f*, because the background is now only capable of faintly phosphorescing, while the part which had the black shadow on it retains its full phosphorescent power. The stenciled image of the luminous cross, unfortunately soon dies out. After a period of rest the glass partly recovers its power of phosphorescing, but it is never so good as it was at first.

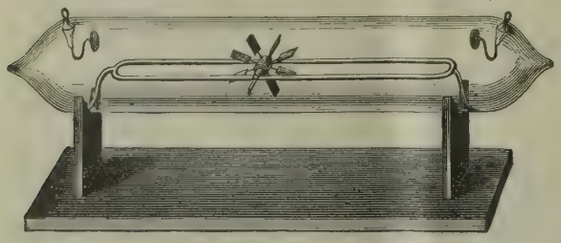


Fig. 11.

Here, therefore, is another important property of radiant matter. It is projected with great velocity from the negative pole, and not only strikes the glass in such a way as to cause it to vibrate and become temporarily luminous while the discharge is going on, but the molecules hammer away with sufficient energy to produce a permanent impression upon the glass.

Radiant Matter Exerts Strong Mechanical Action where it Strikes.—We have seen, from the sharpness of the molecular shadows, that radiant matter is arrested by solid matter placed in its path. If this solid body is easily moved the impact of the molecules will reveal itself in strong mechanical action. An ingenious piece of apparatus has been constructed, which, when placed in the electric lantern, will render this mechanical action visible. It consists of a highly exhausted glass tube (Fig. 11), having a little glass railway running along it from one end to the other. The axle of a small wheel revolves on the rails, the spokes of the wheel carrying wide mica paddles. At each end of the tube, and rather above the center, is an aluminum pole, so that whichever pole is made negative the stream of radiant matter darts from it along the tube, and, striking the upper vanes of the little paddle-wheel, causes it to turn round and travel along the railway. By reversing the poles the wheel can be arrested and sent the reverse way, and if the tube is gently inclined the force of impact will be sufficient even to drive the wheel up hill.

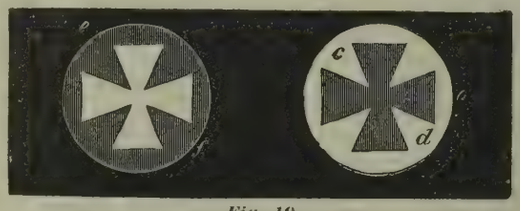


Fig. 10.

This experiment, therefore, shows that the molecular stream from the negative pole is able to move any light object in front of it.

The molecules being driven violently from the pole, there should be a recoil of the pole from the molecules, and by arranging an apparatus so as to have the negative pole movable and the body receiving the impact of the radiant matter fixed, this recoil can be rendered sensible. In appearance the apparatus (Fig. 12) is not unlike an ordinary radiometer, with aluminum disks for vanes, each disk coated on one side with a film of mica. The fly is supported by a hard steel, instead of glass, cup, and the needle point on which it works is connected by means of a wire with a platinum terminal sealed into the glass. At the top of the radiometer bulb a second terminal is sealed in. The radiometer, therefore, can be connected with an induction coil, the movable fly being made the negative pole.

For these mechanical effects the exhaustion need not be so high as when phosphorescence is produced. The best pressure for this electrical radiometer is a little beyond that at which the dark space round the negative pole extends to the sides of the glass bulb. When the pressure is only a few millims. of mercury, on passing the induction current a halo of velvety violet light forms on the metallic side of the vanes, the mica side remaining dark. As the pressure diminishes, a dark space is seen to separate the violet halo from the metal. At a pressure of half a millimeter this dark space extends to the glass, and rotation commences. On continuing the exhaustion the dark space further widens out, and appears to flatten itself against the glass, when the rotation becomes very rapid.

Another apparatus (Fig. 13) illustrates the mechanical force of the radiant matter from the negative pole. A stem *a* carries a needle-point on which revolves a light mica fly *b b*. The fly consists of four square vanes of thin, clear mica, supported on light aluminum arms, and in the center is a small glass cap, which rests on the needle-point. The vanes are inclined at an angle of 45° to the horizontal plane. Below the fly is a ring of fine platinum wire *c c*, the ends of which pass through the glass at *d d*. An aluminum terminal *e* is sealed in the top of the tube, and the whole is exhausted to a very high point.

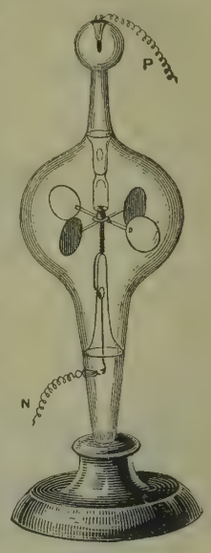


Fig. 12.

By means of the electric lantern an image of the vanes is projected on the screen. Wires from the induction coil are attached, so that the platinum ring is made the negative pole, the aluminum wire *e* being positive. Instantly, owing to the projection of radiant matter from the platinum ring, the vanes rotate with extreme velocity. Thus far the apparatus has shown nothing more than the previous experiments have prepared us to expect; but observe what now happens. By disconnecting the induction coil altogether, and connecting the two ends of the platinum wire with a small galvanic battery, the ring *c c* is made red hot, and under this influence the vanes spin as fast as they did when the induction coil was at work.

Here, then, is another most important fact. Radiant matter in these high vacua is not only excited by the negative pole of an induction coil, but a hot wire will set it in motion with force sufficient to drive round the sloping vanes.

Radiant Matter is Deflected by a Magnet.—We now pass to another property of radiant matter. The long tube (Fig. 14) is very highly exhausted; it has a negative pole at one end and a long phosphorescent screen down the center of the tube. In front of the negative pole is a plate of mica *b d*, with a hole *e* in it, and the result is, when the current is turned on, a line of phosphorescent light *e f* is projected along the whole length of the tube. A powerful horse-shoe magnet is now placed beneath the tube, and under the magnetic influence the line of light becomes curved, waving about like a flexible wand when the magnet is moved to and fro.

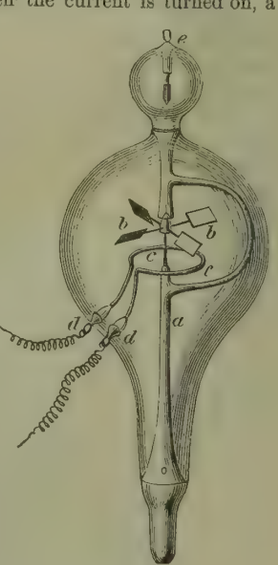


Fig. 13.

This action of the magnet is very curious, and if carefully followed up will elucidate other properties of radiant matter. Fig. 15 is an exactly similar tube, but having at one end a small potash tube, which, if heated, will slightly injure the vacuum. By turning on the induction current the ray of radiant matter will trace its trajectory in a curved line along the screen, under the influence of the horse-shoe magnet beneath. Observe the shape of the curve. The mole-

cules shot from the negative pole may be likened to a discharge of iron bullets from a mitrailleuse, and the magnet beneath will represent the earth curving the trajectory of the shot by gravitation. On a luminous screen the curved trajectory of the shot may be accurately traced. Now suppose the deflecting force to remain constant, the curve traced by the projectile varies with the velocity. If more powder is put in the gun the velocity will be greater and the trajectory flatter, and if a denser resisting medium is interposed between the gun and the target, the velocity of the shot is diminished, and thereby caused to move in a greater curve and come to the ground sooner. The velocity of the stream of radiant molecules cannot well be increased by putting more power in the battery, but it can be tried to make them suffer greater resistance in their flight from one end of the tube to the other. By heating the caustic potash with a spirit lamp a trace more of gas is thrown in. Instantly the stream of radiant matter responds. Its velocity is impeded, the magnetism has longer time in which to act on the individual molecules, the trajectory gets more and more curved, until, instead of shooting nearly to the end of the tube, the molecular bullets fall to the bottom before they have got more than half way.

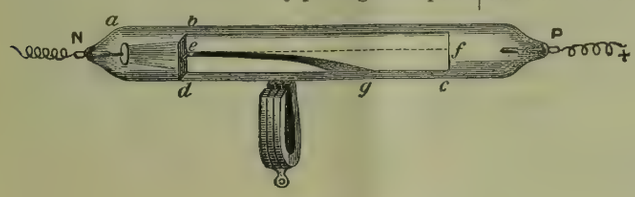


Fig. 14.

It is of great interest to ascertain whether the law governing the magnetic deflection of the trajectory of radiant matter is the same as has been found to hold good at a lower vacuum. Fig. 16 represents a tube of low vacuum. When the induction spark is turned on, it passes as a narrow line of violet light joining the two poles. Underneath is a powerful electro-magnet. In making contact with the magnet, the line of light dips in the center towards the magnet. By reversing the poles, the line is driven to the top of the tube. Notice the difference between the two phenomena. Here the action is temporary. The dip takes place under the magnetic influence; the line of discharge then rises and pursues its path to the positive pole. In the high exhaustion, however, after the stream of radiant matter had dipped to the magnet it did not recover itself, but continued its path in the altered direction.

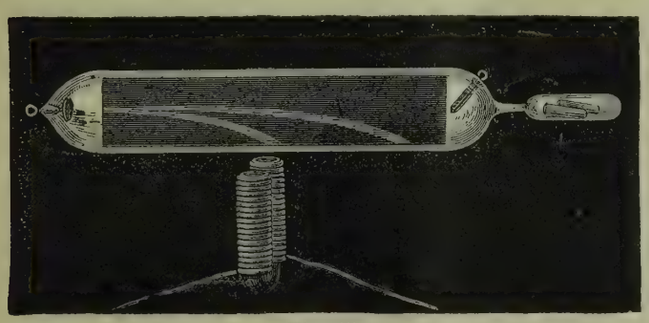


Fig. 15.

By means of a little wheel, skillfully constructed, the magnetic deflection in the electric lantern is shown. The apparatus is represented in Fig. 17. The negative pole *a b* is in the form of a very shallow cup. In front of the cup is a mica screen *c d*, wide enough to intercept the radiant matter coming from the negative pole. Behind the screen is a mica wheel *e f*, with a series of vanes, making a sort of paddle-wheel. So arranged, the molecular ray from the pole *a b* will be cut off from the wheel, and will not produce any movement. A magnet *g* is now put over the tube, so as to deflect the stream over or under the obstacle *c d*, and the result is a rapid motion in one or the other direction, according to the way the magnet is turned. The image of the apparatus is thrown on the screen. The spiral lines painted on the wheel show which way it turns. By arranging the magnet to draw the molecular stream so as to beat against the the upper vanes, the wheel will revolve rapidly as if it were an overshot water-wheel. By turning the magnet so as to drive the radiant matter underneath, the wheel slackens speed, stops, and then begins to rotate the other way, like an undershot water-wheel. This can be repeated as often as the position of the magnet is reversed.

It has been mentioned that the molecules of the radiant matter discharged from the negative pole are negatively electrified. It is probable that their velocity is owing to the mutual repulsion between the similarly electrified pole and the molecules. In less high vacua, such as seen in Fig. 16, the discharge passes from one pole to another, carrying an electric current, as if it were a flexible wire. Now, it is of great interest to ascertain if the stream of radiant matter from the negative pole also carries a current. Fig. 18 is an apparatus which will decide the question at once. The tube contains two negative terminals *a b*, close together at one end, and one positive terminal *c* at the other. This enables the sending of two streams of radiant matter side by side along the phosphorescent screen, or, by disconnecting one negative pole, only one stream.

If the streams of radiant matter carry an electric current, they will act like two parallel conducting wires and attract one another; but if they are simply built up of negatively electrified molecules, they will repel each other.

By first connecting the upper negative pole *a* with the coil, the ray will be seen shooting along the line *d f*. Now bring the lower negative pole *b* into play, and another line *e h* darts along the screen. Notice the way the first line behaves; it jumps up from its first position *d f* to *d g*, showing that it is repelled, and the lower ray may also be deflected from its normal direction; therefore the two parallel streams of radiant matter exert mutual repulsion, acting, not like current carriers, but merely as similarly electrified bodies.

New Process of Obtaining Printing Surfaces.

Some time ago we described a process devised by Mr. Woodbury for obtaining what may be called stereotypes from photographs in such a condition that they could be worked with ordinary type in the printing press. The process adapts itself to so many branches of the arts that a more detailed description will be read with interest. The process is, however patented. When it is desired to prepare a cast of ordinary type or engraved blocks, a mold is taken in any of the usual materials—plaster of Paris or paper. Into this mold is pressed a thin sheet of tinfoil, lead, or other sufficiently ductile metal, the back of which—that is, the depressed surface—is filled up with a solution of gelatinous material which will set sufficiently hard. The compound sheet of tin foil and gelatine thus formed is then removed from the mold, and its metallic face may be used as a surface to be printed from in the usual way, being either laid flat upon the bed of an ordinary printing press, or bent or curved around the surface of the cylinder of a suitable printing machine. The method above described

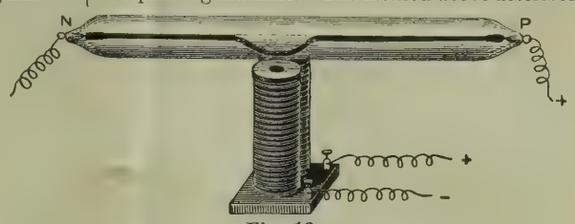


Fig. 16.

may be used to reproduce printing surfaces from blocks or plates of wood, metal or other material having engraved or other designs upon them, as well as from ordinary type; and sometimes, where the subject of the design to be reproduced is of suitable character, and moisture is not present in the printing ink or during the operation of printing, gelatine, or gelatinous material, may be poured directly into the cast or mold, without the intervention of tin or other metal foil, and the gelatine surface so obtained may itself be used when dry as a printing surface without the intervention of the metallic face. The gelatine or gelatinous material may be hardened and rendered more impervious to water by the addition of a small

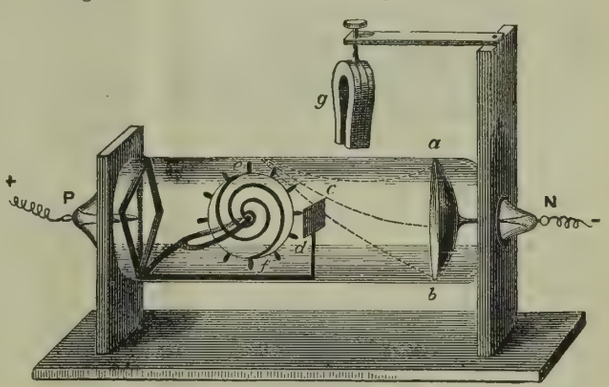


Fig. 17.

quantity of chrome or other alum, or any substance capable of hardening gelatine and rendering it insoluble. The surface of the tin foil which forms the printing surface, or of the gelatine, is preferably electroplated with a deposit of nickel, steel or other hard metal, for the purpose of rendering it more durable, and such deposit may be effected upon the surface of the sheet either before it is applied to and pressed into the cast or mold, as described, or after the compound printing surface has been completed. In cases where it is desired that the printing surface to be produced shall be more or less soft or flexible, so that it may be used as a hand or other printing stamp, gelatine or other gelatinous material, to which has been added a sufficient quantity of glycerine or other substance, such as sugar, capable of rendering the mixture sufficiently soft, flexible and elastic when dry, is used as a back to the tin foil.

The process may be applied to the reproduction of designs or pictures obtained by means of photography, in the following manner: Upon a plate of glass a

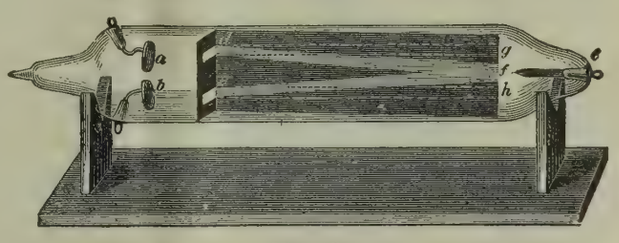


Fig. 18.

gelatinous printing surface of any desired design or picture is prepared by means of light in the ordinary well-known way. Upon the printing surface so prepared, a sheet of tin foil, preferably electroplated with a harder metal, is placed, and being covered

with a number of thicknesses of blotting paper, is passed through an ordinary rolling press, until the metal foil is pressed into intimate contact with every part of the gelatine printing surface, every detail of the design upon which is thus reproduced upon the back of the metal. The surface so prepared and covered with the tin or other metal foil may be used for printing from in an ordinary printing press; or, where the subject requires it, as, for instance, where half-tones are to be produced, pictures or impressions may be obtained by means of gelatinous ink, more or less transparent, applied to the printing surface, and thence transferred to paper placed upon it, either by means of a flat plate of glass or other material pressed down by any suitable press or by weights. When it is necessary that the design of the pictures produced should not be reversed, Mr. Woodbury uses a white pigment, which he transfers to black or colored paper, or a positive instead of a negative photographic picture, in order to obtain the gelatine printing surface. In the methods above described, in order to make the tin foil adhere to the gelatine when it is pressed against and into the design, the surface of the gelatine is covered with a thin solution of india rubber in benzole. The tin or other foil pressed upon it adheres perfectly when dry.

The Conservation of Solar Energy.—Dr. C. William Siemens has lately contributed to the Royal Society an interesting paper, in which he develops a highly ingenious hypothesis upon the manner in which heat of the sun is maintained. He rejects as insufficient, to account for the maintenance of the solar heat, the hypothesis of gradual shrinkage advanced by Helmholtz, and accepted by Young and other astronomers; also that of Mayer, which seeks to account for it by the mechanical impact of meteors falling upon the solar surface from great distances in space; and likewise that of Sir William Thomson, who explains it on the hypothesis of a simple transfer of heat from the interior of a liquid sun to the surface by convection currents, which last named is the hypothesis at present supported by Prof. Stokes and other leading physicists.

He then proceeds to elaborate his own hypothesis, which he bases upon the following grounds, which he endeavors to substantiate: First, that the interstellar spaces are filled with gaseous matter in a very attenuated condition; that this gaseous matter consists of hydrogen, hydro-carbons, oxygen, etc.; that these gases are attracted in enormous quantities towards the polar surfaces of the sun; that during their gradual approach they pass from their condition of extreme attenuation and extreme cold to that of compression, accompanied with rise of temperature, until, on approaching the photosphere, they burst into flame, giving rise to a great development of heat and a temperature commensurate with their point of dissociation at the solar density. The result of their combustion will be aqueous vapor, and carbonic anhydride or oxide, according to the sufficiency or insufficiency of oxygen present to complete the combustion; and these products of combustion, in yielding to the influence of centrifugal force, will flow towards the solar equator, and will be thence projected into space.

He then considers what would become of these products of combustion when thus rendered back into space. Apparently they would gradually change the condition of stellar material, rendering it more and more neutral; but here the author suggests the highly interesting explanation that it is probable that solar radiation, would, under these circumstances, step in to bring back the combined materials to a condition of separation by a process of dissociation carried into effect at the expense of that solar energy which is now supposed to be lost to our planetary system. This probability he bases on the results obtained by himself in certain experiments in which he affirms that he obtained unmistakable evidence of the dissociation of aqueous vapor at a temperature of 22° C. (corresponding to a vapor pressure of 1-1800 of an atmosphere), by the simple action of solar radiation. These results are of the highest importance, as they confirm the view held by advanced physicists that radiant energy from a source of high intensity (like that of the sun) possesses a dissociating power far surpassing the measurable temperature to which the compound substance under its influence is raised.

The direct bearing of these views on Dr. Siemens' investigation is apparent. Assuming the correctness of his observation that aqueous vapors were really dissociated in the experiment just named; and, assuming further, that stellar space is filled with aqueous and other vapors of a density not exceeding 1-1200 of an atmosphere, it is reasonable to suppose that its dissociation would be effected by solar radiation, and that the solar energy supposed to be lost in space would thus be utilized. By means of the fan-like action resulting from the rotation of the sun, the vapor dissociated in space to-day, would be drawn towards the polar surface of the sun to-morrow, be heated by increase in density, and would burst into flame at a point where both their density and temperature had reached the necessary elevation to induce combustion, each complete cycle, however, taking years to be accomplished. The resulting aqueous vapor—carbonic anhydride and carbonic oxide—would be drawn towards the equatorial regions, and be again projected into space by centrifugal force.

By this ingenious and plausible hypothesis, the solar rays traversing space are made to perpetually furnish the fuel for the maintenance of combustion upon the solar surface.

An Historical Lightning Rod.—The lightning rod which for over fifty years had been attached to the residence of the late Prof. Robt. Hare, for many years the Professor of Chemistry in the University of Pennsylvania, and which was removed when the old dwelling house was demolished to make way for the imposing edifice of the new post office, now nearly completed, was lately placed in the custody of the Franklin Institute.

There are some facts in connection with this relic which are of special interest, and which were brought out by the editor of this journal in his monthly report as secretary at the last meeting of the Institute. The following is a brief abstract of the remarks made in connection with this subject. This interesting relic is thus described by Prof. Hare in the edition of his "Chemistry" published in 1840: "I have surmounted the lightning rod, by which my mansion is protected, by 17 copper wires, pointed at one end and at the other soldered into a hole drilled in the rod, which is constructed of iron. The junction is surrounded by a globe of zinc of about 2 inches in diameter, above which the wires extend divergingly. The copper wires, by their association with zinc, are protected from oxidation, while their greater fusibility, as compared with the platinum point usually employed, is compensated by their number. The rod thus mounted rises about 10 feet above the apex of the roof, to the copper covering of which its lower end is soldered. The copper covering has an ample metallic connection with the pipe for carrying off the rain, and this pipe with those of the public waterworks, all the joints being made with screws or solder. By these means a most ample means of communication with the earth is obtained. Analogous means should be employed in the case of all lightning rods in situations where access can be had to a similar ramification of metallic pipes."

After reading the above extract, the secretary noted as an interesting fact, that the method employed at that early day by Prof. Hare corresponds in every essential particular with the best practice in vogue today for protecting buildings from injury by lightning. The protective influence exerted by the union of the copper points with the zinc globe, as noted by Prof. Hare, was alluded to as a fact of special interest, the condition of the points after nearly half a century's exposure to atmospheric influences showing a remarkable state of preservation, being now almost as sharp as when the rod was first put up.

Improvements in the Rapid Working of the Basic Process.—Mr. Wm. M. Henderson, a well-known engineer, formerly of Philadelphia, but at present in the employ of the Pennsylvania Steel Co., at Steelton, Pa., has communicated to us the details of what appears to be a very simple method of facilitating the working of the basic process. The improvement resides in a considerable simplification of the manner of renewing the linings of converters, and consists in turning the ordinary pillow blocks, into which the converter trunnions revolve, into wheels about 30 inches in diameter, by means of which the converter may be run in and out of working position for use and for repairs, the track consisting of the girders usually provided.

We are informed that a 10-ton converter, empty of metal, and with the bottom removed, in condition for removal, weighing about 30 tons, can be wheeled away by two men at the rate of about 25 feet per minute, for which purpose a power truck is provided, geared 5 to 1, with winch handles. When this is coupled to the converter it forms with it a vehicle which may readily be wheeled away.

Mr. Henderson claims for this invention a number of advantages over the removable shell system, of which the following are perhaps the most important: It dispenses with the necessity of raising the converter to the impracticable hight of 20 feet above the general ground level; with the necessity of having a special and extra powerful hydraulic lift for raising and lowering the shells; and with the intermediate ladle and crane between the converter and the ingot ladle. It provides room underneath the converters for the introduction of the gas main and pipes to rapidly dry the converters after relining. The converter, being made to connect again with a hydraulic cylinder and rack in the repair shop, is as manageable while undergoing relining and repairs as when working. It can be turned round to any desirable position to facilitate relining and repairs. Another advantage is the ease and rapidity with which a converter can be set free for removal, and replaced by another in working condition, by the simple removal of two chocks which lock the wheels in working position.

The importance of having some prompt, unlaborious way of changing converters, will be best understood by reference to the fact that, while a converter for conducting the ordinary Bessemer process requires renewal about every three months, a converter for the basic process must be renewed about every sixty hours; and as the lining of such a converter would occupy from fifteen to twenty hours of time, the quicker it is removed for this purpose and replaced by another ready to continue the work the better for the out-put.

Metallic Caesium.—Setterberg has prepared metallic caesium in considerable quantities by the electrolysis of a mixture of four molecules of caesium cyanide and one molecule of barium cyanide. The metal obtained was almost chemically pure, showing in the spectroscope only a trace of sodium. Caesium closely resembles the other alkaline metals. It is silver-white, malleable, and very soft at ordinary temperatures. Thrown on water, it bursts into flame, and swims about on the surface like potassium and rubidium. It inflames spontaneously in the air when not protected. (It is the only metal that behaves in this manner). Its point of fusion is 26.5° C. (=79.7° Fah).), passing through a pasty condition. Its specific gravity is 1 88.

Caesium, it may be stated for the benefit of such of

our readers as are unfamiliar with its history, was discovered nearly twenty years ago by Bunsen, together with rubidium, in exceedingly minute quantities, in the waters of the Dürkheim mineral spring. Its discovery was made with the aid of the spectroscope, then just devised.

Artificial Quinine (?).—E. J. Maumené has lately deposited with the French Academy a sealed packet purporting to contain the evidence of his discovery of a method of effecting the synthesis of quinine. M. Maumené accompanies his sealed packet with the following letter: "The discovery of H_2N has just furnished me with the means of realizing a synthesis desired by all chemists, and the object of a reward offered by the society. This synthesis is that of quinine. I would at once communicate to the Academy the details of the very simple operation in which H_2N furnishes very pure sulphate of quinine, if it were not proper that I should first submit to medical proofs this sulphate, all the properties of which are identical with those of the sulphate prepared from quinquina."

The above announcement may possibly herald the accomplishment of an important and highly valuable discovery; but the manner in which it is made, the mysterious business of the sealed packet, seems to us to savor of what in plain English is called "humbug." This view is shared by the editor of the *American Chemical Journal*, who severely, and we think justly, criticises the mysterious sealed-packet method of announcing discoveries, as being "specially adapted to the encouragement of abortions, which are common enough without the necessity of being made respectable by a great academy."

Canals on the Planet Mars.—The Rev. T. W. Webb, author of "Celestial Objects for Common Telescopes," writes thus to the London *Times* respecting Schiaparelli's discovery of "canals" on the planet Mars: "It has long been known that the surface of the planet Mars is so mapped out into brighter and darker portions as to suggest the idea of continents and oceans, and the analogy thus implied with the arrangements of our own globe is strengthened by the existence of brilliant white patches, as of snow or ice, situated at or near the planet's poles of rotation, and varying in extent with its changing seasons, as well as by occasional differences in outline or coloring, which may well be explained by the supposition of a vaporous atmosphere.

"In the autumn of 1877 and spring of 1878, a number of minute, straight, black or dusky bands were detected by Schiaparelli, traversing and subdividing the supposed continents in various directions. These have been called, from their aspects, 'canals,' though, of course, their scale entitles them rather to the appellation of straits, or very long, narrow arms of the sea. A few of these had been previously seen by various observers, but to the Italian astronomer belonged the credit of developing and delineating them as a system. At the ensuing return of the planet in 1879–'80, they were again detected and drawn by him, with very little difference. But during the course of last January and February, he has been so fortunate as to perceive the duplication of these dark streaks by the addition of parallel lines of similar character and length in no fewer than twenty instances, covering the equatorial region with a strange and mysterious network, to which there is nothing even remotely analogous on the earth, and which leads us at once to see how premature have been our conclusions in this respect, and how far we still are from any adequate conception of the real constitution even of our nearest neighbor but one in the solar system."

Storage of Electricity.—In a lecture lately delivered before the Royal Institution by Prof. Ayrton, on the storage of energy, the lecturer maintained that, making due allowance for the unnecessary waste due to the too hurried charging and discharging of a Faure accumulator, for a million foot-pounds of stored energy discharged with a mean current of 17 ampères, the loss in charging and discharging combined, need not exceed 18 per cent; and he affirmed that he has found it in some cases not to exceed 10 per cent. He makes the additional statement, from experiment, that 81 pounds of lead and red lead, charged and discharged, the discharge lasting 18 hours—6 hours on three successive days—represented in its discharge 1,440,000 foot-pounds of work, or one horse-power for three-quarters of an hour.

The recuscitating power of the Faure accumulator was found to be wonderful. After the 18 hours of discharge just referred to, it was found, after a few hours of insulation, that the accumulator could give a current of over 50 ampères. The phenomenon resembles the invigorating action of sleep.

The Darwinian Creed.—Those who themselves explicitly reject the Darwinian creed, yet cannot possibly escape from many of its implications. It runs through almost all the best thought of our time; it tinges our unformed public notions; it reappears under a hundred disguises in works on law and history, in political speeches and religious discourses, in artistic theories and vague social speculations. Our very novels and poems are full of latent Darwinian germs. If we try to think ourselves away from it, we must think ourselves away entirely from our own age. Whoever builds at all must build largely from materials supplied by Darwin or by Darwinians. Whoever deals with social forces must deal with forces greatly molded and remodeled by Darwinian ideas. The physician who wholly neglected Darwinian results would fall behind in the race—would, in fact, be naturally selected for quiet extinction; the statesmen who wholly overlooked the political and ethical implications of the Darwinian belief, the strength of the new intellectual factors introduced by Darwinism, would be incapable of really guiding the political thought of to-day.

How Coal is Formed.—Prof. Reinsch, in a lecture lately delivered, gave the results of his researches regarding the manner in which coal had been formed. He had examined with the microscope not less than 2,500 sections of coal, and had come to the conclusion that coal had not been formed by the alteration of accumulated land plants, but that it consisted of microscopic forms of a lower order of protoplasm, and although he had carefully examined the cells and other remains of plants of a higher order, he computed that they have contributed only a fraction of the mass of coal veins, however numerous they may have been in some instances. He referred to the fact that Dr. Muck, of Bochum, held that algæ have mainly contributed to the formation of coal, and that marine plants were rarely found in coal because of their tendency to decompose, and that calcareous remains of mollusks disappeared on account of the rapid formation of carbonic acid during the process of carbonization.

A New Sweet Substance.—At a recent meeting of the German Technical Society, Dr. Constantine Fahlberg read an interesting paper describing a scientific research which had resulted in his discovery of a new body, possessing to an eminent degree the property of sweetness. The new substance would be called, in chemical language, "anhydro-sulphaminbenzoic acid." It is a white crystalline substance, very soluble in alcohol, but sparingly soluble in water, and has the property of sweetness to such an eminent degree that the merest trace of the alcoholic solution in water suffices to impart a distinctly sweet taste to it. The discoverer estimates that it has from 20 to 30 times the sweetness of cane sugar. The new substance may come in time to have important technical uses.

Potash Salts and Alum from Feldspar.—A recent procedure for manufacturing salts of potash and alum from feldspar, consists in treating the pulverized mineral with sulphuric acid and fluorspar. The hydrofluoric acid liberated by the action of the sulphuric acid on the fluorspar, decomposes the silicate, and the potassa and alumina set free combine with the excess of sulphuric acid to form sulphates. It is only necessary, when the action is complete, to add a certain quantity of water, and then to decant off the supernatent liquid, when the alum will crystallize out. Large quantities of alum are at present manufactured in this manner.

Action of Manganese on Brass.—It is said that an alloy composed of 70 per cent of copper and 30 per cent of manganese is used in Germany as an addition to brass and bronze to increase the density, toughness and ductility of these metals. The utility of the addition of the manganese alloy is based upon the well known energetic affinity the last named metal has for oxygen, in virtue of which it prevents the formations of oxides of copper or tin while it is present, and eliminates such oxides when they have already been formed. Metallic manganese is also recommended for the same purpose. The addition of from $\frac{1}{4}$ to 1 per cent of manganese, or from $\frac{1}{2}$ to 3 per cent of the manganese alloy to bronze or brass, is affirmed to produce castings quite free from blow holes. The addition of a larger percentage of manganese than the above named proportions has the effect of hardening the metal.

Expansion of Metals on Cooling from Fusion.—An interesting series of experiments are reported to have been made by Messrs. Nies and Winkelman on the changes in volume of a number of metals on cooling from fusion. Of the eight metals (tin, lead, zinc, bismuth, cadmium, antimony, iron and copper) submitted to investigation, six—namely, tin, zinc, bismuth, antimony, iron and copper—expanded at the moment of solidification, so that the solid is less dense than the liquid metal. The results obtained with the remaining two metals were not decided, though it is believed that they also expand on solidification. The authors are of opinion that their experiments indicate the existence of the general law that all metals expand on solidification.

The Proportion of Carbonic Acid in the Upper Regions of the Atmosphere.—Messrs Müntz and Aubin have lately made a number of carefully conducted determinations of the carbonic acid in air collected at the summit of the Pic du Midi, a peak of the Pyrenees 2,877 meters high. The average of their results gave 2.86 volumes in 10,000, a quantity corresponding very closely with that obtained by the same authors on the plain of Vincennes. From these results, it would appear that this gas is very uniformly distributed in the atmosphere, a view which confirms that of other investigators of the subject.

The Action of Light on Oxygen.—M. Dessans is authority for the statement that oxygen is converted, by the action of intense light, into ozone. He has devised an apparatus for governing the admission of the radiations of a Drummond light into a jar of oxygen; and as the result of frequently repeated experiments, he affirms the fact of the direct transformation of the oxygen into ozone.

The Absence of Individual Death is shown to be a characteristic of the *protozoa*, by Dr. O. Bütschli. These mono-cellular animals cease to exist as such in the act of propagation, but the individuality of each is split up into two new individualities of its offspring. A protozoön may die by accident, but it does not necessarily carry, like the higher animals, the germs of death in itself.

The Safest Anæsthetic.—From an examination of statistics compiled by Dr. Andrews, of Chicago, and Dr. Richardson, of London, ether is by far the safest of anæsthetics, only one death occurring from it in the course of 23,204 administrations. Bichloride of methylene causes death once in 5,000 instances of its use.

The Proportions of Riveted Joints.

While it will be disputed by no one familiar with the subject, that the safety, strength and durability of a steam boiler depend as much on the proper riveting of its joints as upon any other factor entering into its construction, it is also true that in so important a matter as this, there are wide variations between the practice of different boiler makers in proportioning joints for different thicknesses of plates. As a matter of fact, it appears that in this important element of boiler construction there is more reliance in most cases on rule of thumb, based on experience gained in practice, than on calculation, the consequence of which is that few boiler makers succeed in using their materials to the best advantage.

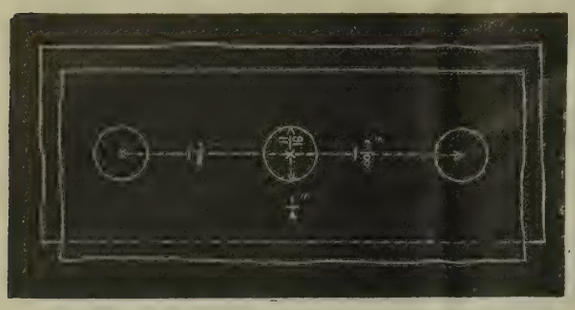


Fig. 1.

To obtain the greatest strength of a riveted joint with the least expenditure of material and labor, the diameter and pitch of rivets should be so proportioned that the shearing strength of the rivets shall be equal to the tensile strength of the section of the plate left between rivet holes. As the tensile strength of ordinary boiler plate is practically equal to the shearing strength of rivet iron, it is only necessary to make the area of the rivet holes equal to the net section of plate after punching, in order to properly fulfill the conditions of correct proportion. In practice, however, it appears that this condition is rarely fulfilled, nor is it even attempted to approximate to it. This assertion can be readily supported by examining the practice of different boiler makers, of which a number of instructive examples are appended. For instance, we find one maker using the following proportions: Plate, $^5/_{16}$ inch thick; rivet, $\frac{3}{4}$ inch diameter; pitch, $2\frac{1}{8}$ inches; and plate, $\frac{1}{2}$ inch thick; rivet, $\frac{3}{4}$ inch diameter; pitch, 2 inches. Another maker uses the following: Plate, $^5/_{16}$ inch thick; rivet, $\frac{3}{4}$ inch diameter; pitch, $1\frac{7}{8}$ inches; and plate, $\frac{1}{2}$ inch thick; rivet, $\frac{3}{4}$ inch diameter; pitch, $2\frac{1}{2}$ inches. From the discrepancies shown between the proportions in these examples, it is apparent that in one or the other of these cases very little judgment has been exercised. These proportions are in daily use by the boiler makers from whom they were obtained, and in each case the parties are satisfied that theirs are the only correct ones.

To determine the relative strength of the plate and rivet at the joint, we have only to apply the following simple rule, when the plate and rivet are both iron:

$$\frac{\text{Pitch} - \text{diameter of rivet holes}}{\text{Pitch}} = \text{equals the percentage of strength of plate at joint as compared with solid plate.}$$

$$\frac{\text{Area of rivets} \times \text{number of rows of rivets}}{\text{Pitch} \times \text{thickness of plates}} = \text{equals the percentage of strength of rivets at joint as compared with solid plate.}$$

Subjected to the test of analysis by the above rules, the practice of a number of the best boiler makers throughout the country, which have been obtained for the purpose, shows very wide discrepancies, some proving to give good proportioning, and others very bad. The results of this comparison are given in what follows, and the illustrations are self-explanatory: Referring to Fig. 1, we have, plate $\frac{1}{2}$ inch thick; rivet holes, $^{11}/_{16}$ inch diameter; pitch of rivets, $1\frac{7}{8}$ inch.

$$\text{Strength of plate at joint} = \frac{1.875 - .6875}{1.875} = 63 \text{ per cent of solid plate.}$$

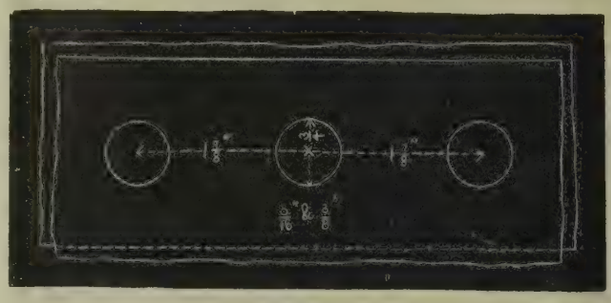


Fig. 3.

$$\text{Strength of rivets at joint} = \frac{.37122}{1.875 \times .25} = 79 \text{ per cent of solid plate.}$$

The rivet strength is greatly in excess of that of the plate, hence the pitch should be increased. This would give a stronger joint with less work and material.

Fig. 2.—Plate, $\frac{1}{4}$ inch thick; rivet holes, $^{11}/_{16}$ inch diameter; pitch of rivets, 2 inches.

$$\text{Strength of plate at joint} = \frac{2 - .6875}{2} = 66 \text{ per cent of solid plate.}$$

$$\text{Strength of rivet at joint} = \frac{.37122}{2 \times .25} = 74 \text{ per cent of solid plate.}$$

A stronger joint than Fig. 1, although there is still an excess of strength in rivets.

Fig. 3.—Plates, $^3/_{16}$ inch and $\frac{3}{8}$ inch thick; rivet holes, $\frac{3}{4}$ inch diameter; pitch of rivets, $1\frac{7}{8}$ inch.

Strength of plates at joint

$$= \frac{1.875 - .75}{1.875} = 60 \text{ per cent of solid plate.}$$

$$\text{Strength of rivets in } ^5/_{16} \text{ inch plate} = \frac{.44179}{1.875 \times .3125} =$$

75 per cent of solid plate.

Strength of rivets in $\frac{3}{8}$ inch plate

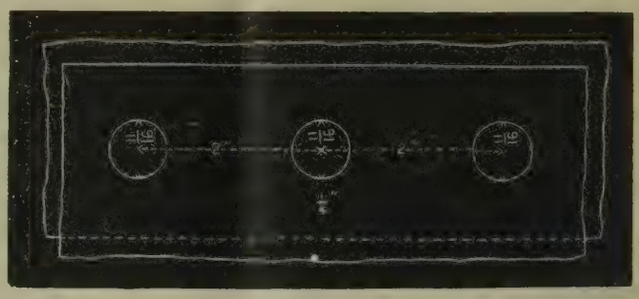


Fig. 2.

$$= \frac{.44179}{1.875 \times .375} = 70 \text{ per cent of solid plate.}$$

Too many rivets; pitch should be increased. It is impossible to proportion joints correctly with different thicknesses of plates, and the same sized rivets and equal pitches.

Fig. 4.—Plate, $^5/_{16}$ inch thick; rivet holes, $\frac{3}{4}$ inch diameter; pitch of rivets, 2 inch.

$$\text{Strength of plate at joint} = \frac{2 - .75}{2} = 62\tfrac{1}{2} \text{ per cent of solid plate.}$$

$$\text{Strength of rivets at joint} = \frac{.44179}{2 \times .3125} = 71 \text{ per cent of solid plate.}$$

Plate cut away too much; the rivets should be spaced farther apart.

Fig. 5.—Plate, $^5/_{16}$ inch thick; rivet holes, $^{13}/_{16}$ inch diameter; pitch of rivets, $2\frac{1}{8}$ inches.

$$\text{Strength of plate at joint} = \frac{2.125 - .8125}{2.125} = 62$$

$$\text{Strength of rivets at joint} = \frac{.51849}{2.125 \times .3125} = 78 \text{ per cent of solid plate.}$$

Pitch about right; the rivets larger than necessary.

[*To be Continued.*]

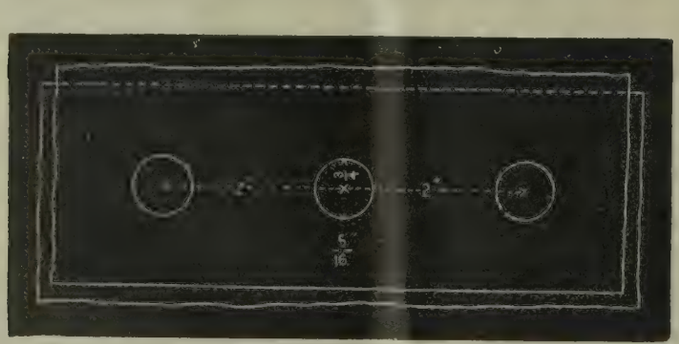


Fig. 4.

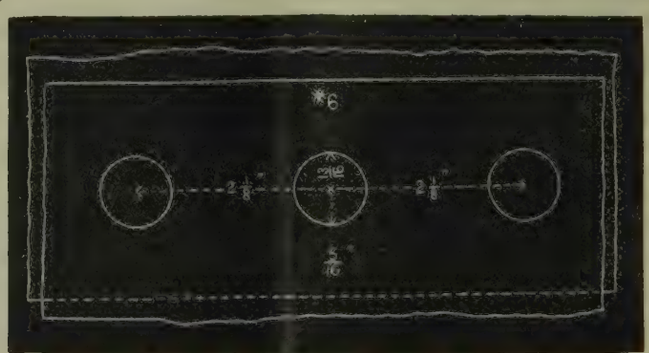


Fig. 5.

The Power in Coal.—Few realize what an enormous amount of power is stored up in coal, and how little we really utilize. Professor Rogers has put it neatly thus: The dynamic value of one pound of good steam coal is equivalent to the work of a man a day, and three tons are equivalent to twenty years' hard work of 300 days to the year. The usual estimate of a four-foot seam is, that it will yield one ton of good coal for every square yard, or about 5,000 tons for each acre. Each square mile will contain 3,200,000 tons, which in their total capacity for the production of power, are equal to the labor of over 1,000,000 able-bodied men for twenty years.

Market Report of Building Materials.

NEW YORK PRICES.

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LUMBER.

Pine, very choice and extra dry, ₱ M	$60 00 @ 70 00
Pine, good	55 00 @ 60 00
Pine, shipping box	21 00 @ 22 50
Pine, common box	18 00 @ 20 00
Pine, common box ⅝	16 00 @ 18 00
Pine, tally plank, 1¼, 10 inch, dressed each	— 44 @ — 50
Pine, tally plank, 1¼, 2d quality	— 35 @ — 38
Pine, tally plank, 1¼, culls	— 28 @ — 30
Pine, tally boards, dressed, good	— 30 @ — 32
Pine, tally boards, dressed, common	— 25 @ — 28
Pine, tally boards, culls, dressed	— 23 @ — 25
Pine, strip boards, merchantable	— 18 @ — 20
Pine, strip boards, clear	— 24 @ — 26
Pine, strip plank, dressed, clear	— 33 @ — 35
Spruce boards, dressed	— 25 @ — 27
Spruce plank, 1¼ inch, dressed	— 28 @ — 30
Spruce plank, 2 inch	— 43 @ — 45
Spruce wall strips	— 15 @ — 16
Spruce timber, ₱ M	20 00 @ 25 00
Hemlock boards, ₱ M	17 00 @ 18 00
Hemlock joist, 2½x4, each	— 16 @ — 17
Hemlock joist, 3x4	— 18 @ — 20
Hemlock joist, 4x6	— 40 @ — 44
Ash, good, ₱ M	55 00 @ — —
Oak	60 00 @ 65 00
Maple culls	25 00 @ 30 00
Maple good	45 00 @ 50 00
Chestnut	48 00 @ 52 00
Cypress, 1, 1½, 2, and 2½-inch	35 00 @ 40 00
Black Walnut, good to choice	115 00 @ 125 00
Black walnut, ⅝-inch	85 00 @ 100 00
Black walnut, selected, and seasoned	150 00 @ 175 00
Black walnut, counters, ₱ ft	— 22 @ — 28
Cherry, wide, ₱ M	100 00 @ 120 00
Cherry, ordinary	60 00 @ 80 00
White wood, inch	45 00 @ 50 00
White wood, ⅝-inch	35 00 @ 40 00
White wood, ⅝ panels	45 00 @ 50 00
Shingles, extra sawed pine, 18-inch	4 00 @ 5 00
Shingles, clear sawed pine, 16-inch	3 75 @ 4 00
Shingles, cypress, 24x6	18 00 @ 20 00
Shingles, cypress, 20x6	10 00 @ 12 00
Lath, Cargo rate	2 00 @ — —
Yellow dressed pine flooring	30 00 @ 40 00
Yellow pine girders	32 50 @ 40 00
Locust posts, 8 feet, ₱ inch	— 18 @ — 20
Locust posts, 10 feet	— 24 @ — 25
Locust posts, 12 feet	— 29 @ — 34
Chestnut posts, ₱ ft	— 3 @ —3½
Basswood ₱ M	25 00 @ 30 00

Cargo rates 10 ₱ cent off.

CEMENT—PER BARREL.

Portland (imported)	2 65 @ 2 85
Portland (American)	2 50 @ 2 75
Portland (Lafarge)	3 30 @ 3 65
Lime of Teil	2 30 @ 2 50
Lime of Teil, ₱ ton	15 00 @ 18 00
Roman	2 75 @ 3 25
Keene's & Martin's, coarse	6 00 @ 6 50
" fine	10 50 @ 10 75
Rosendale	1 10 @ 1 20

SOLDERS.

Half and half	15½ @ — 15¾
Extra	14½ @ — 14¾
No. 1	13 @ — 13¼

ZINC.—Duty, sheet, ₱ ℔, 2½ cents.

Sheet (cask) ₱ ℔	7⅞ @ — 8
Sheet (open)	8¼ @ — 8½

BRICKS.

	Cargo.		Afloat.
Pale, ₱ M	4 25	@	4 50
Up Rivers	6 00	@	6 50
Jersey	5 50	@	6 00
Haverstraw Bay	6 75	@	7 00
" " choice	7 12½	@	7 25
Favorite Brands	7 50	@	— —
Hollow Fire-Clay Brick	9 00	@	9 25

FRONTS.

Croton—Brown, ₱ M	11 00 @ 12 00
" Dark	12 00 @ 14 00
" Red	12 00 @ 14 00
Philadelphia	35 00 @ — —
Trenton	35 00 @ — —
Baltimore	45 00 @ — —
Clark's Glens Falls, White	30 00 @ — —
" " Red Fronts	27 50 @ — —
" " Molded Red and White	45 00 @ 80 00

Yard prices 50 cents ₱ M higher, or with delivery added $2 ₱ M for hard and $3 ₱ M for front brick. For delivery add $5 on Philadelphia, Trenton and Glens Falls and $6 on Baltimore brick.

STONE.—Cargo Rates Delivered in New York.

Amherst Sandstone, No. 1, buff, in rough, ₱ c. f.	1 00 @ — —
do do No. 2	— 85 @ — 95
Bedford Stone	1 25 @ — —
Berlin Freestone, in rough	— 75 @ 1 00
Berea Freestone, in rough	— 75 @ 1 00
Brown Stone, Portland, Conn	1 00 @ 1 35
Bay of Fundy Wood Point Brown Stone	1 00 @ — —
do Mary Point Brown Stone	1 00 @ — —
do do Olive Stone	1 00 @ — —
Brown Stone, Belleville, N. J	1 00 @ 1 35
Granite, rough	— 60 @ 1 25
Canaan Marble	1 25 @ 1 50
Sutherland Falls Marble	1 25 @ 1 75
Dorchester, N. B., Stone, rough, ₱ foot	1 00 @ — —

LEAD—PER 100 POUNDS.

German	— — @ — —
English, common	— — @ — —
Spanish	5 75 @ — —
Foreign, refined	— — @ — —
Bar	6 50 @ — —
Sheet	7 50 @ — —
Pipe	— @ — —
Domestic	4 63 @ — —

TIN PLATES.—Duty, 1 7/10 cents ₱ ℔.

I. C. charcoal, 10x14, ₱ box	6 25 @ 6 50
I. C. coke, 10x14	5 25 @ 5 75
I. X. charcoal, 10x14	8 25 @ 8 37½
I. C. charcoal, 14x20	6 25 @ 6 50
I. X. charcoal, 14x20	8 25 @ 8 37½
I. C. coke, 14x20	5 25 @ 5 75
I. C. coke, terne, 14x20	5 25 @ 5 37½
I. C. charcoal, terne, 14x20	5 50 @ 5 7[illegible]

NAILS—PER KEG.

10d to 60d, common, fence and sheathing	3 30 @ 3 40
8d and 9d, common	3 65 @ — —
6d and 7d, common	3 90 @ — —
4d and 5d, common	4 15 @ — —
3d and 4d, light	4 95 @ — —
3d, fine	5 65 @ — —
2d, fine	5 65 @ — —
Cut spikes, all sizes	3 65 @ — —
Clinch nails, 1½ to 1¾ inch	5 65 @ — —
do. 2 to 2½ inch	5 40 @ — —
do. 2½ to 2¾ inch	5 15 @ — —
do. 3 inch and longer	4 90 @ — —

IRON—PER TON.

Duty.—Bar, 1 to 1½c. ₱ ℔. ; Railroad, 70c. ₱ 100 ℔. ; Boiler and Plate, 1½c. ₱ ℔. ; Sheet, Band, Hoop, and Scroll, 1¼ to 1¾c. ₱ ℔. ; Pig, $7 ₱ ton ; Polished Sheet, 3c. ₱ ℔. Galvanized, 2½c. ₱ ℔. ; Scrap cast, $6 ₱ ton ; Scrap Wrought, $8 ₱ ton—all less 10 ₱ cent. No Bar Iron to pay a less duty than 35 ₱ cent ad val.

Pig, Scotch—Coltness	25 00 @ 26 00
" Glengarnock	24 00 @ 24 50
" Eglinton	22 50 @ 23 50
" American, No. 1	25 00 @ 26 00
" American, No. 2	23 50 @ 24 00
" American forge	22 00 @ 22 50

PAINTS.

Carmine, American, ₱ ℔	5 00 @ 5 25
Chalk, ₱ 100 ℔s	— 35 @ — —
China Clay, ₱ ton	18 00 @ 20 00
Chrome yellow, dry, ₱ ℔	— 12½ @ — 28
Lead, red American, ₱ ℔	— 6¾ @ — 7
Lead, white American, pure, in oil	— 7½ @ — 8
Lead, white American, pure, dry	— 6¾ @ — 7
Lead, white English, pure, in oil	— 9 @ — 10
Litharge	— 6¾ @ — 7
Ocher, Fr., dry, ₱ 100 ℔s	1 50 @ — —
Ocher, ground, in oil, ₱ ℔	— 6 @ — 15
Ocher, Vermont, ₱ 100 ℔s	— 75 @ 1 00
Orange Mineral, English	— 9 @ — 10
Paris White, American	— 1½ @ — 1¾
Paris White, English, prime	— 2 @ — 2¼
Paris Green	— 15 @ — 28
Plumbago paint, patent, ₱ ℔	— — @ — 25
Putty, ₱ ℔	— 2 @ — 2½
Spanish Brown, dry, ₱ ℔	— 1⅛ @ — 1¼
Spanish Brown, ground in oil, ₱ ℔	— 8 @ — 9
Venetian red, ₱ cwt	1 75 @ 2 00
Vermilion, Chinese, ₱ ℔	— 85 @ — 90
Vermilion, Trieste	— 70 @ — 75
Vermilion, quicksilver, bags	— 50 @ — 52½
Vermilion, American, common	— 15 @ — 18
Whiting, ₱ 100 ℔s	— 60 @ — 80
Zinc, white American, dry, No. 1	— 5 @ — 7½
Zinc, white American, No. 1, in oil	— 8 @ — 10
Zinc, white French, dry, (Red Seal,)	— 7 @ — 8
Zinc, white French, in oil	— 10 @ — 10½

VARNISHES—PER GALLON.

American Wearing Body	3 50 @ 4 00
Coach Body	2 35 @ 3 50
" "	1 80 @ 2 00
Furniture	1 25 @ 2 50
Black Asphaltum	1 00 @ 1 50
Brown Japan	1 00 @ 1 20
Liquid Paint Dryer	1 35 @ 1 75
Harness, (black)	3 00 @ 4 50
Shellac, Spirits	3 00 @ 3 50

LIME—PER BARREL.

State, common	— 85 @ — —
" finishing	1 15 @ — —
Rockland, common cargo rate	— 90 @ — —
" finishing	1 20 @ — —
Ground	— 85 @ — 90

Add 25 cents to above figures for yard rates.

HAIR.

Cattle, ₱ bushel of 7 ℔s	— 17 @ — 18
Goat " "	— 25 @ — 28

SLATE.

Purple, roofing slate, ₱ square	$6 00 @ 7 00
Green Slate	6 00 @ 7 00
Red Slate	13 00 @ — —
Black Slate, Pennsylvania, (at Jersey City)	4 75 @ 5 25
Slate tiles, 1¼-inch, rubbed, ₱ square foot	— 20 @ — 25

PLASTER PARIS.

Duty.—20 ₱ cent ad. val. on calcined ; lump free.

Calcined, ordinary city, ₱ bbl	1 35 @ 1 45
Calcined, city casting	1 50 @ 1 65
Calcined, city superfine	1 70 @ 1 75

MAHOGANY.

St. Domingo, crotches, ordinary to good, ₱ ft	— 15 @ —28
St. Domingo, crotches, fine	— 20 @ —30
St. Domingo, logs, small	— 5 @ —38
St. Domingo, logs, large	— 12 @ —15
Frontera, Mexican, large	— 12 @ —15
Frontera, Mexican, small	— 6 @ — 8
Other Mexican	— 6 @ —12½
Honduras	— 6 @ —12½

ROSEWOOD.

Rio Janeiro, ordinary to good, ₱ ℔	— 2½ @ — 4½
Rio Janeiro, good to fine	— 5 @ — 8
Honduras	— 6 @ — 12½
Satin Wood, ₱ foot	— 15 @ — 75
Tulipwood, ₱ ℔	— 6 @ — 7
Lignumvitæ, large, ₱ ton	30 00 @ 50 00
Lignumvitæ, other sizes	10 00 @ 25 00

CEDAR.

Cuba and Mexican, small, ₱ super. ft	6 @ — 7½
Cuba and Mexican, medium	8 @ — 9½
Cuba and Mexican, large	10 @ —11
Florida, ₱ cubic foot	40 @ —75

DEADENING AND ROOFING MATERIAL.

Mineral wood for Roofs and deadening, ₱ ℔	— 1¼ @ —1½

LABOR.

Ordinary, ₱ day	2 00 @ 2 50
Masons, do	3 50 @ 4 00
Plasterers, do	4 00 @ — —
Carpenters, do	4 00 @ — —
Plumbers, do	4 00 @ 4 50
Painters, do	3 00 @ 3 50
Stone-Cutters, do	3 00 @ 3 50

REVIEW OF THE MARKETS.—In the lumber market the past month business has been dull and uninteresting.

In the brick market some irregularity has been shown for common hards, with the tendency rather in buyers' favor if anything. The changes, however, have been very slight, and, on the whole, there was a pretty well preserved tone.

In the lime market business has been somewhat irregular, with the changes in cost favorable for buyers. The accumulation of common Eastern becoming quite full, holders found that to move it quickly a shading on price must be made. The rate was accordingly put down to 90 cents per barrel. This had the desired effect, and started a more liberal movement, with the tone of late a little steadier, though no actual reaction can be advised. Finishing remains as before. State lime has also receded in cost and sold down to 85 cents, with rumors of a lower figure, the market showing some irregularity.

In the lath market trade has continued a little tame all around, with a further shading made on cost.

In the hardware market business has been slow, and, indeed, almost at a standstill on most home outlets, with the tone of the market unsettled. Accumulations of stock and general assortments are equal to any ordinary call, with production still in progress, no difficulty with the workmen having taken place.

In the metal markets Scotch pig has not been very actively sought after, but there was a moderate supply offering for early delivery, with no pressure to realize upon lots to arrive, and values well maintained throughout. American pig has had a firm and promising look as compared with the situation a short time ago. Demand has shown no unusual volume or force, but has been of a very steady character. Cheap outside lots of stock seem to have become all absorbed, and the accumulation left is valued at full or slightly hardening figures, with more or less indifferent offering. Manufactured iron has not been very active, and the market without features of special interest. No great surplus of stock can be found offering, while on prices about former figures are asked. Domestic pig lead has continued in moderately active demand, the movement embracing in the main only such lots as the immediate wants of consumers required. Supplies, however, have remained under control, and owners quite determined in the asking of pretty full rates, and there has been no evidence of pressure to realize from any quarter. Pig tin has found a firm market, stimulated by the cheerful accounts from abroad and the general favorable situation of the stock here. Offerings have been small and quite indifferently made. Tin plates have been without much variation, a moderately active trade taking place and about old rates ruling steadily. Zinc has been in moderately active demand and steady.

In the nail market business has not been very heavy, and was confined in the main to the ordinary run of small orders from regular sources. Stocks have been fair in amount, and offered to the extent of the call with former rates current.

In the paint market demand has been moderate and uncertain, and the market indeed quite dull on all outlets.

A NOVEL APPARATUS FOR SEPARATING GOLD from sand was recently completed and tested in this city. It is intended for use in the placer regions of the West, Mexico and Central America, where gold-bearing sand is found at a distance from water sufficient for hydraulic mining. The machine is about five feet in diameter, and is arranged to throw the sand by centrifugal force against a "wall" of mercury, maintained in position by centrifugal action. In this way, it is claimed, every particle of gold is brought in contact with the mercury and amalgamated, while the sand is blown away by means of an air-blast. The machine is said to clean a ton of sand in twenty minutes, and to be so thorough in its operation as to make it possible to work over with profit the tailings of mines worked by other systems. The power required to operate the machine is not given.

The Clinton Wire Cloth Company.

Some facts relating to the domestic history of this highly successful company, whose products were fully described in our issue for May last, have been brought to our notice, and we present herewith such portions thereof as may be of interest.

Like most of the great manufacturing establishments in the country to-day, the Clinton Wire Cloth Company had a very humble and modest origin. The office of the company in 1856, when operations were commenced, was in such contracted quarters that a desk 2×3 feet, a man who performed the complex duties of book-keeper, manager, foreman, designer, financial agent, etc, a few books and a chair, sufficed to crowd it uncomfortably. With the growth of the company's business, which at the present time has reached such a state that its products are in demand in every section of the country, the necessity for enlargement from time to time became imperative, and during the past year a number of important extensions of its buildings have been made.

The present office is one of a number of buildings finished during the past year. It stands on the northeast corner of the company's grounds, and is three and a half stories high. It is a handsome brick building with white granite trimmings, the lower floor of which is used for storing pattern lumber. The main offices are on the first story, which is divided into suitable apartments to accommodate the rooms of superintendent, manager, book-keepers, clerks, etc.

The prominent feature of this building is the fact of its being entirely built on what is known as "mill construction"—plank floor on timbers. The object of the company has been to show that with such construction the highest artistic effects are possible and easily attained. That this is so the most skeptical can be convinced on viewing the premises of the company. The ceiling of the lower story is plastered on the timbers, which are in panels. Each room presents a different style of workmanship, producing a handsome effect. The second floor is devoted to the draughting department and the storage room for patterns.

The company has shown its faith in the claims it puts forth in behalf of the fire-proof qualities of its wire cloth for constructive purposes, by employing it extensively in its own building, which, although the floors and partitions are of wood, is claimed to be entirely fire-proof. Wire lath has been used on the ceilings, walls and partitions. The lath is half an inch from the brick and the wood, held off by furrings; plaster is then forced through the wire lath, leaving a sufficient coat on the outside of ordinary thickness. At a test in Boston, a fire was started in a room that was covered with 4-inch Georgia pine plank, protected on the under side with wire lath and plastered in the usual way, and after two hours and twenty minutes burning in as heavy a fire as they could make, the timber was not browned, but remained perfectly protected. The roof of the office is a very common sense arrangement. It is a fire-proof roof of the following construction: First, the rafters 15 inches from centers; on these wire lath is fastened with staples, then a strip ¼×⅝ inch is nailed on the lath up and down the rafters, a coat of mortar is put on—just enough to go through the lath and clinch, leaving it ¼ inch on the top of the lath; then the furrings for the slate are put on and nailed to the rafters, these furrings being 1×2 inches and the plaster 1 inch, making it even with the furrings. The slate is then nailed on in the usual way.

We notice that O. B. Potter, of this city, is using wire lath in his building at the corner of Broadway and Astor Place, showing he does not intend to meet with a similar loss as the burning of the old *World* building. Had that building been plastered on wire lath, with either brick partitions or studding protected with wire lath, it would have required hours for the fire to have extended beyond the room in which it originated.

The mills number from 1 to 6, and are now running full capacity, giving employment to between 400 and 500 hands. The manufacturing capacity of the mills is, of window screen cloth about 30,000,000 square feet; other wire cloth and netting, 12,000,000 to 15,000,000 annually. The company now has a force of 35 mechanics at work building new looms, and is pushing the sale of its goods throughout the United States from Maine to California, and doing a constantly increasing exporting trade.

The present organization of the Clinton Wire Cloth Co. is as follows: President, C. H. Waters; Treasurer, C. F. Fairbanks; Manager, C. Swinscoe; Superintendent, H. J. Brown, Accountant, C. M. Alley.

Second Annual Fair of the New England Manufacturers' and Mechanics' Institute.

Remembering our promise of last month to give further details concerning the character and scope of the exhibition of this Institute, which will be held during the months of September and October next, so soon as they were at disposal, we are gratified to be able to add much that is of interest to the brief notices that have appeared.

The mode in which this institution originated afforded almost a positive guarantee that it would achieve a pronounced success. As we glean from reliable sources, it originated in Boston among some of the prominent manufacturers and their representatives, who felt the need of a system of exhibitions which should be more truly representative of current industrial and mechanical progress than such as were already in the field there and elsewhere, which had drifted from force of circumstances or want of proper management into directions which afforded little or nothing of interest or profit to the intelligent manufacturer or consumer of manufactured products. A corporation was accordingly formed under the distinguishing title above named, for the purpose of carrying out their ideas of reform in the system of exhibitions, and which comprises among its membership nearly a thousand manufacturers of New England, many of whom rank with the most prominent of their class. A suitable location was at once selected, and a fine exhibition building erected upon it, which was opened for exhibition purposes last year for the first time. The success of this experiment, as most of our readers are aware, was remarkable, and in every way gratifying to its originators.

The exhibition of this year, which will open on the 6th of September, if one may judge from the arrangements that have already been made, will considerably surpass in extent and general interest that of 1881. The dimensions of the building given below will give a general idea of its capability, under enterprising management, of accommodating a great exhibition. The actual area of the ground floor is 207,654 square feet, or nearly 5 acres; the gallery and hall added to this make a total area of floor space within the building of 351,834 square feet—more than 8 acres, all well lighted, ventilated and available for exhibition purposes. The total length of the building is 551½ feet and 403 feet 4 inches wide. A large, well lighted and pleasant room is set off as a restaurant; retiring rooms, with all the necessary adjuncts, offices and all the generally required conveniences, are embraced under this one roof. The building contains 15 miles of steam, gas and water pipes; an abundance of power will be provided to run machinery, and long lines of shafting for the transmission of power are distributed through the building. The lighting will be done principally by electricity.

Of the features of general interest that will be displayed at the forthcoming exhibition, we can only indicate the more important. Many parties who last year exhibited only a portion of their productions, have applied already for more than double the space of last year. This is true very generally of the manufacturers of steam engines, machine tools, and of textile machinery and manufactures. The electric lighting companies will be fully represented; and the differential high-pressure air engine, which excited much attention last year, will be shown in greatly improved form. From the number and variety of applications already made, the managers do not entertain the slightest doubt that the forthcoming exhibition will be much larger than that of 1881.

One of the most interesting and valuable features of the forthcoming exhibition will be the exhibit of the Richmond & Danville Railroad Company, who will display the splendid collection of the products of the fields, forests and mines of the country its road traverses. This exhibit attracted unusual attention at Atlanta, and is said to be a most remarkable and instructive one. The city of Richmond will likewise be represented by a variety of exhibits of its manufacturing establishments.

Last year one of the most instructive exhibits was that showing the entire process of manufacturing boots and shoes, as most of our readers will recall from our articles. It is intended this year to extend this valuable feature, and to vary it. This year the process of manufacturing cotton goods of various kinds from the raw material, or some similarly instructive process of manufacture, will probably take the place of the boot and shoe manufacture of last year.

The Willimantic Linen Co. will show in operation the special machinery they have introduced for spinning fine linen thread. Of other leading manufacturers who will participate with representative displays, we have been favored with the names of the Lowell Machine Shop; the Mason Machine Works, of Taunton, Mass.; Crompton, of Worcester; the Knowles Loom Works, of the same place; while the manufacturers of machine tools, we are informed, will be much more fully represented than last year.

The general arrangement of the exhibits will be varied from that of 1881; the ground floor will be more fully occupied with machinery, and the textile fabrics arranged in the gallery. This year arrangements have been made to accommodate a department of the fine arts, which could not be done last year for want of time. This, it is expected, will prove a very interesting feature. A large display of musical instruments is likewise anticipated.

One of the unique features of the management of this exhibition, is the rule of the corporation not to grant medals, or other awards, by which wise provision much of the jealousy and dissatisfaction that invariably find their way into other exhibitions where the old custom is followed, are avoided. The public is left to judge of the merits of the exhibits; the exhibition company show all exhibitors the same attention and equal opportunities, and let the exhibits speak for themselves.

The managers have found it necessary to commence the allotment of space on the first of July, and intending exhibitors should lose no time in sending in their applications. No charge is made for space, and the managers announce that every facility will be given to exhibitors in aiding them to get their exhibits in place.

Parties desiring further information are invited to communicate at the earliest moment to J. F. Wood, Treasurer, 38 Hawley street, Boston, Mass.

NEW PLANING MILLS.—The planing mill of Jesse Hoyt, at East Saginaw, Mich., is being rebuilt on the site of the one recently burned. The new structure will be larger than the old one, and will contain all the latest improvements in the way of construction and machinery. It will be as near fire-proof as such a building can be made, and an engine of 150 horse power will be required to drive the machinery. The entire outfit of machinery, including the shafting, pulleys, etc., is being furnished by the S. A. Woods Machine Company. This company has also just sold, through its Chicago house, an entire complement of machinery for an extensive planing mill and sash, door and blind factory, just built at New Orleans by Samuels & West.

The Proper Time for Work.

The habit of writing and reading late in the day and far into the night, "for the sake of quiet," is one of the most mischievous to which a man of mind can addict himself. The feeling of tranquility which comes over the busy and active man about 10.30 or 11 o'clock ought not to be regarded as an incentive to work. It is, in fact, the effect of a lowering of vitality consequent on the exhaustion of the physical sense. Nature wants and calls for physiological rest. Instead of complying with her reasonable demand, the night-worker hails the "feeling" of mental quiescence, mistakes it for clearness and acuteness, and whips the jaded organism with the will until it goes on working. What is the result? Immediately the accomplishment of a task fairly well, but not half so well as if it had been performed with the vigor of a refreshed brain working in health from proper sleep. Remotely, or later on, comes the penalty to be paid for unnatural exertion—that is, energy wrung from exhausted or weary nerve-centers under pressure. This penalty takes the form of nervousness, perhaps sleeplessness, almost certainly some loss or depreciation of function in one or more of the great organs concerned in nutrition. To relieve these maladies—springing from this unexpected cause—the brain-worker very likely has recourse to the use of stimulants, possibly alcoholic, or it may be simply tea or coffee. The sequel need not be followed. Night work during student life, and in after years, is the fruitful cause of much unexplained, though by no means inexplicable, suffering, for which it is difficult, if not impossible, to find a remedy. Surely morning is the time for work, when the whole body is rested, the brain relieved from its tension, and mind power at its best.

The Electric Light.

It has occurred to us that an elementary statement of the facts and principles underlying the production of the voltaic arc, commonly known as the electric light, might be serviceable to those of our readers who have had no opportunity of familiarizing themselves with the subject, and whose want of familiarity with the technical terms employed in descriptions of electric lighting processes may make the reading of articles relating to that important subject a task instead of a pleasure. We have, therefore, prepared in the following a simple statement of the elementary facts bearing on the subject.

The luminous effects of the electric current are among the most interesting of physical phenomona. If we break asunder the conductor conveying the current from a powerful galvanic battery at any point, a brilliant flash of light will be seen instantaneously at the broken part. If the ends of the wire conductor are connected with two pencils of hard carbon, or some other conducting material, and brought together, and then slowly separated, a brilliant arc or light, called the "voltaic arc," will continue to pass between the carbon poles or electrodes, unless they are too widely separated, when the current can no longer pass and the light ceases. As our readers are all aware from the appearance of the electric lights now so commonly in use, the light of the voltaic arc is of dazzling brilliancy, and the arc itself is of the most intense source of heat that can be produced by artificial means. The cause of this luminous phenomenon will be made clear by the following explanation.

When the carbon poles are separated from each other, portions of the positive pole are volatilized by the current of electricity and are carried through the air to the negative pole, thus forming a "bridge of vapor" over which the electricity continues to pass. The positive carbon decreases in size and the negative carbon increases. Besides this, as the intensely heated carbons are surrounded by air, they are gradually burned away by ordinary combustion. The condition of the carbon points while burning, is shown in the cuts Figs. 1 and 2, which are exact reproductions of photographs of the electric light. By taking a series of these and comparing them, it will be found that while there is a slow consumption of the negative carbon, there is at the same time a constant stalagmitic growth of particles carried from

Fig. 1.

Fig. 2.

the positive carbon by the action of the electric current. These deposits assume different forms and build up gradually, growing narrower near the base (as seen in the figures), until, by a weakening of the current which this causes, and the continued consumption of the upper carbon, the piece drops off. The constant repetition of this operation is the cause of the slight but frequent "flicker" which all of our readers will have noticed in the electric lights.

The action just named—that is, the slow consump-

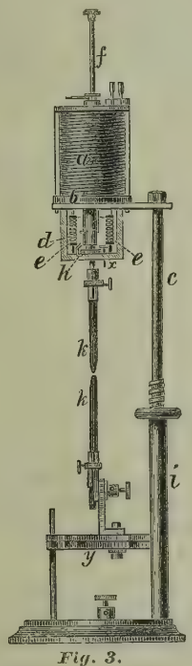


Fig. 3.

tion of the carbon poles by combustion, and the growth of the negative carbon at the expense of the positive, renders it necessary to devise some means by which the carbons shall be kept at a uniform and proper distance apart; for if they should be allowed to get too far apart, the current ceases to flow and the light goes out, in which case the carbons must be brought together again and slowly separated before the light reappears. To accomplish this important point, automatic regulators of a great variety of forms and principles of construction have been devised, which have for their object the keeping of the carbons a certain uniform distance apart. One of the many forms of these regulators is shown in Fig. 3, in which the actuating power is an electro-magnet, which is made more or less powerfully magnetic by the variations in the intensity of the current flowing. As the carbons burn away, the increased length of the electric arc increases its resistance and weakens the magnetism of the helix, and then the coil, rod and carbon move downward by the action of gravity, until, by the shortening of the arc, the magnetism of the helix is strengthened and the downward movement arrested. By these and similar means, the regulators automatically maintain the carbons in proper position. We may in future offer plain explanations of other important facts and principles involved in the interesting operation of the electric light.

Give the Boy a Chance.

Thomas F. Hagerty contributes to the *American Machinist* the following interesting article:

How many boys, who, having chosen a trade and entered into their apprenticeship, have been doomed to remain inferior workmen because of being denied a fair opportunity of developing the best that was in them, would be hard to estimate. The young apprentice, if he is satisfied with the trade he has chosen, and has ambition to equal, if not excel, some of his fellow apprentices, will naturally look for, and expect to, receive encouragement from some source. He looks up to the older apprentice, to the journeyman, to the superintendent, or to his employer for advice, and in most instances receives a cold reply to his inquiries. The best boys are generally the timid ones; the forward boy, in many cases, not being treated as kindly as the boy who seems to lack self-esteem. There is always a "spark of human kindness" extended to those who seem most dependent on others. And in no place should this generous feeling be so liberally shown as in the machine shop, where the names of the tools and the nature and perplexing variety of the work to be done would puzzle the mind of a timid boy.

Therefore, those having control of either men or boys, should use civil and polite language in giving directions, keeping in mind the fact, that, should the head get impatient and ill-tempered, every member will be affected in like manner. A boy should receive every encouragement and advice until he has sufficient self-reliance to depend on his own ability to do a job unaided; every chance should be given him to learn all that is requisite to make him a thorough mechanic, as it is as much injury to the reputation of a shop to turn out an inferior workman (a chunker) as it is to turn out an inferior and defective engine or tool.

The employer or foreman should not be always watching the apprentice in hopes of detecting him wasting either time or material; for if a boy has an idea in his head which he desires to perfect—whether it be in the shape of a pair of legs made into calipers, a try-square, in the "truth" of which *he* has implicit reliance, an accenter punch, hammer or tool, or may be a valuable shop hint, that had escaped your sight—you can rely upon it he will find (not steal) both time and material to do the job to his liking. He is boss of that job, and you may depend upon it.

That reminds me of an incident that occurred during the last year of my apprenticeship. The practice at that time was to employ many apprentices and very few journeymen. One of the partners of the firm generally acted as foreman—the reverse of this is the practice of the present day. A task of so many pieces was set before each boy or man as a day's work; all work over that number was paid for by the piece. The tools in use at the time were of the most inferior kind, and each hand had to keep his own lathe and bench tools in order in his own time. Any tool which could be devised to aid in performing the task in less time was eagerly sought for. One part of the work occupied two hours' time every day, which, with the proper tool, specially designed for

the purpose, could have been done better and more uniform in five minutes.

I conceived the idea of inventing a tool to do this job, but fearing to receive the usual brutal rebuff from the boss, I set to work to perform the task in my own time. I devoted my spare hours at night to the drawing, and half the dinner hour every day to the pattern, until it was finished. I had castings made, and the parts finished and ready to put together and try on the first opportunity I could get.

The boss came "nosing around" the boys' bench drawers, and in mine he found the prospective device, which would have given him a monopoly of one branch of his business had not his own meanness prevented it. His discovery embraced a frame and a few small shafts and screws, two little grooved wheels and a bifurcated lever and handle. I am charitable enough to believe that he supposed that it was some kind of a toy I was making at the expense of his time and material; but without waiting for an explanation, he began to curse and fret, and finally broke up my device with a hammer and threw the parts into the scrap heap.

I had no redress left me, as to attempt a remonstrance with him would have led to fisticuffs, therefore I had to grin and bear it. I need hardly say that when my apprenticeship time expired I left the shop, and that a rival shop received the benefit of that and many other inventions, which enabled them to manufacture and sell their goods more cheaply than before. Several patents were issued years afterwards to other parties for the application of the principles embodied in my device, for other purposes.

This is one of many instances which I could relate where the first efforts of the apprentice to bring out and apply his individual talent was checked by ignorant and unkindly rebuffs. Therefore, I say give the boy a chance.

The Saving of Sanitary Science.

We take the following suggestive extract from a letter of Edwin Chadwick to the London *Morning Post*, and shall await with interest the conclusions Dr. Richardson will reach after the examination referred to:

"Dr. Littlejohn, the health officer of Edinburgh (which has about half the population of Glasgow), informs me that during the last decade a saving of 4,000 lives has been effected, mainly by the clearance of the worst parts of the town under the authority of their Improvement Act, and by the early notification of infectious diseases, and by their early discovery and isolation of the cases by which the spread of epidemic diseases is prevented. He states that those clearances have cost the ratepayers $2,500,000. This outlay should be redeemed by a payment of some $150,000 per annum of principal and interest in some thirty years; but it will be found to effect a reduction of the cost of funerals and sickness in such proportions as is specified in the instances of Glasgow; and Edinburgh, I estimate, admits of nearly as great a reduction of its sickness and death rate. Our earliest examinations of the sanitary conditions and the preventable sickness and mortality in towns were of necessity incomplete and one-sided. We have not, then, the means of ascertaining, even proximately, the extent of waste and of money loss attending it; nor have we now, except proximately. We have the one item for the death rate and the estimated sickness rate, but we have not statistics to give us the extent of the loss entailed upon the adults of the clearly wage classes by the extent of loss by disability from sickness alone. I am fully aware that those I have taken may be challenged as wide under estimates. So, therefore, are the means of payment for effectual means of relief. I am glad to state that I have succeeded in introducing our great physician and sanitarian, Dr. Richardson, who has examined most closely the preventatives of diseases, to make what I call a clinical examination of the city, to get out the consequences and costs of insanitary conditions more completely than has hitherto been done. He is doing it for Brighton, and I have no doubt he will present an important example for the use of other cities, especially such heavy death-rated cities as Manchester and Dublin, and those in the United States."

Tenth Cincinnati Industrial Exposition.

The managers of the Cincinnati Industrial Exposition have just sent us a copy of the "Rules and Regulations and Premium List" of their tenth annual exposition of manufactures, products and the arts, in the form of a neatly printed pamphlet of some 75 pages, illustrated with a perspective view of their handsome exhibition building and plans of the several floors.

We have only space in this issue to state that the exhibition will be open to the public from Wednesday, September 6th, to Saturday, October 7th, 1882. The reception of goods will begin on Wednesday, August 16th. Application for space may be made at any time. The Cincinnati annual expositions have achieved a very high reputation among the manufacturers of the country by reason of their representative character, and the dignity and propriety with which all details relating thereto have been conducted; and we doubt not that the same excellent management that has gained an enviable reputation for these annual exhibitions in the past will insure a continuance of their success. We must defer a full description of this exposition until our August number.

In the meantime all necessary information relating to the exhibition, which may be desired by intending exhibitors, can be obtained by addressing Wm. H. Stewart, Secretary Cincinnati Industrial Exposition, Cincinnati, O.

Pulley Blocks and Trucks.

The Penfield Block Company, of Lockport, N. Y., inform us that the demand for their Anchor Brand pulley blocks and trucks is steadily increasing, and has obliged them to nearly double their force and capacity within the last year. Their present stock, however, is more complete than ever before, which, with their increased facilities, enable them to fill promptly new orders, which, at one time, would necessarily have taken some time to execute.

Ever on the alert for something new, they have just brought out an improved snatch block, called the Anchor Snatch Block, in which the old and troublesome shackle pin and chain is done away with, and for which they solicit a trial. Their truck business, which was established but a little more than a year ago, has increased much in excess of their expectations, which is owing probably to the superior quality of the goods manufactured. Their phosphor-bronze, self-lubricating bushing is also becoming very popular. Their new 40-page illustrated catalogue will soon be out, and will be mailed free upon application. Henry B. Newhall, of 105 Chambers street, is their New York agent.

Fugitive Inks.—The aniline violet pencils now extensively used in this country, as well as inks made of the same coloring matter, must be understood to produce writing of a very fugitive character; well enough, perhaps, for amatory correspondence, which, in order to be in character with the feeling that prompts it, is possibly better to be of a somewhat transient kind. It is, however, different with most writing, and permanence is commonly recognized as an essential characteristic; and, as we have said, this quality does not belong to inks of the aniline violet series. A druggist whom we know found out this to his cost. He labeled some of his bottles with purple ink of a most telling brilliancy, but some time after was much surprised to find that not a trace of the writing was to be seen. The light effectually bleaches the aniline and we have noticed that exposure in a damp place produces the same effect.

Miscellaneous and Advertising.

Foot-power machinery for workshop use will be sent on trial if desired, by W. F. & John Barnes, of Rockford, Ill.

Girard College, Philadelphia, is to have a complete amchine shop, with a work bench, forge, and gas engine, for each of the 90 pupils in practical mechanics.

The Geo. Place Machinery Company, of 121 Chambers street, this city, have always on hand a large line of new and second-hand machinery of every description.

"How to Keep Boilers Clean," and other valuable information for steam users and engineers. Book published by James F. Hotchkiss, 84 John street, New York. Mailed free to any address. (Mention this paper.)

The Dean Brothers Steam Pump Works, of Indianapolis, Ind., are making three large pumps for the new steel works at Indianapolis. They have just shipped one of their pumps to Edmore, Mich., for supplying that town with water. They have also shipped one of their large double plunger pumps to the Sloss furnace, at Birmingham, Ala.

W. P. Davis, of North Bloomfield, N. Y., ran his works day and night, from January 1st to April 1st, when he increased his facilities until he thought he could keep up with orders. Now he is again obliged to start up on overtime, and states that, judging from letters received from users of his machines, he will continue to have a large sale for some time to come.

L. Morrison, agent of the Jarvis Furnace Company, of 18 Second street, Baltimore, Md., has contracts for, and is now setting, two tubular boilers, built by John T. Coleman & Sons, Baltimore, Md., for W. H. Evans, marble works, Spring Garden, Baltimore, to burn screening mixture; one steel tubular boiler for Messrs. John H. Vonderhorst & Son, brewers, Baltimore, to burn wet hops with soft coal; three tubular flue boilers for Messrs. Harvey & Bro., Wellsbury, W. Va., to burn soft slack; and two tubular boilers, built by the Westinghouse Steam Engine Co., Pittsburgh, Pa., for the Allegheny County Light Co., Pittsburgh, Pa.

Design for a Country House.

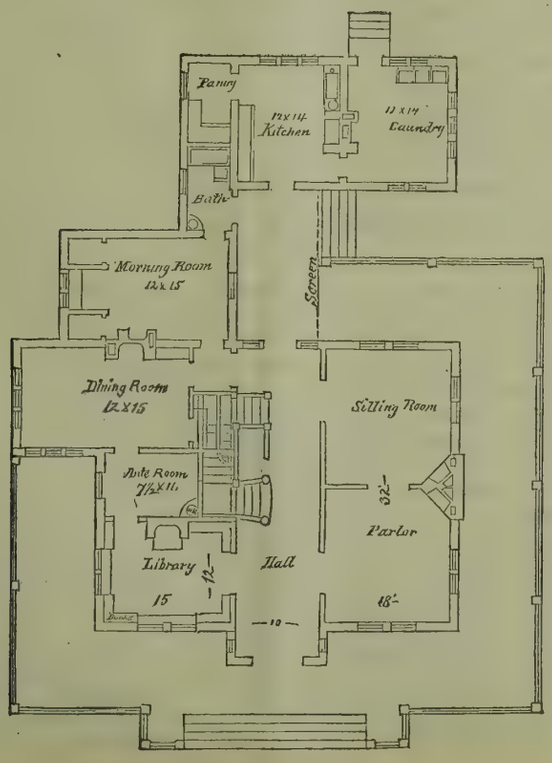
The dwelling shown on the opposite page was designed for erection in Santa Fé, New Mexico, and prepared or arranged to secure the accommodation required in a Southern climate, by a resident from the North.

The construction differs from the ordinary method in respect to the walls, which are built of framed work, and exposed, not covered with weather boarding, but planed off to receive oil stain or paint. The studding or joists are filled in, or nogged, with concrete or adobe, instead of bricks, and finished flush or evenly with the inside face of the studs, and floated true and smooth, to receive a coat of white hard finish. The ceilings in this mode of construction are not plastered, but formed by the naked floor beams and floors, which are painted or stained, the upper surface of the floors being lined with narrow mill-worked boards, and underlaid with thick sheathing felt or paper, to deaden sounds.

The rooms on the first floor are of the following dimensions: Parlor, 16×18 feet; sitting-room, 16×18 feet; library, 12×15 feet; ante-room off library, 7×11 feet; dining-room, 12×15 feet; morning-room, 12×15 feet; kitchen, 12×14 feet; laundry, 11×14 feet. On the second floor there are five bedrooms corresponding in size to the rooms below.

This house can be constructed in the neighborhood of New York city for about $5,500. The architect is Mr. D. T. Atwood, of 335 Broadway, New York.

DESIGN FOR A COUNTRY HOUSE.

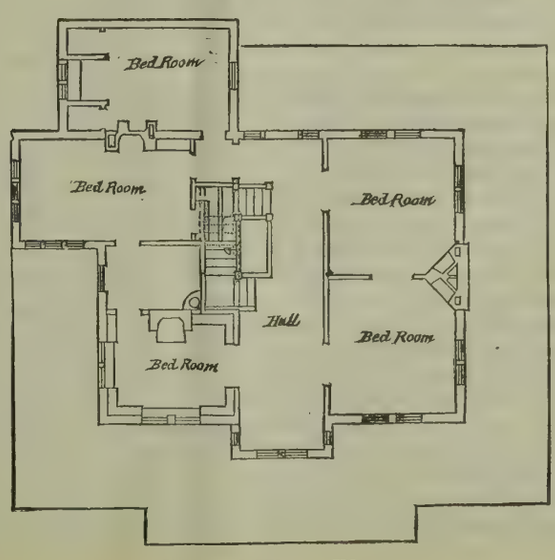


First-Floor Plan.

ESTIMATED COST

OF

CONSTRUCTION $5,500.



Second-Floor Plan.

The Quality of American Beers.

In a recent communication to Commissioner of Internal Revenue Raum, on topics affecting the interests of the brewing industry, the brewers, through a committee, made some interesting statements respecting the employment of malt substitutes, which we shall make the subject of a few comments. As we have already presented some opinions in this journal on a subject closely related to that expressed in the title of this article, those of our readers who were sufficiently interested to read our former article, will not fail to notice how closely the statements made therein are corroborated by the declarations of the brewers themselves in their communication to the Commissioner. The representatives of the brewing interest affirm, the extravagant statements of the New York *Sun*, and the re-hash of the same served up by the Philadelphia *Times*, to the contrary notwithstanding, that they are satisfied that the greater part of the brewers in the country use nothing but malted barley and hops, although abroad, they suggestively add, where much attention is paid by the government to the goodness of beer, the practice is the other way.

We are satisfied that the first portion of this statement is strictly true, and that by far the greater portion of the beer brewed in the United States will compare favorably in purity, excellent flavor and nutritious qualities with that brewed in the most favored localities of the Old World. Respecting the use of malt substitutes, which has been such a bugaboo to the *Sun* and the *Times*, the explanation offered by the brewers' committee places the responsibility upon the brewers of the old country, where it properly belongs.

The writer of the lengthy article in the New York *Sun*, which we criticised some months ago, agitated himself into a condition of extreme excitability over the discovery—of the credit for which no one will dispute his authorship—that the frightful and reckless adulteration of beer was purely the outgrowth of American ingenuity; that such a thing was quite unknown in the Fatherland; and that no one who had ever tasted beer would drink the thinly disguised slops, with which American brewers satisfied the depraved and vitiated taste of American beer-drinkers. Leaving at present out of sight other gross and obvious exaggerations of statement contained in the article referred to, and which were pointed out in our former article, we are specially interested here in noticing the manner in which the assertion contained in it, that the use of malt substitutes in beer brewing, is particularly an American practice, is disposed of by the brewers' committee in their communication to the Commissioner. On this point they speak as follows: "We find our course—that is, the use of the best malted barley and hops—to be the easiest and most profitable. But since the introduction of vinous and light colored beers from Europe, the taste of the public has been for a different looking product, and this is to be had by a lighter colored malt, or by the addition of the same or similar grain unmalted, or by both; therefore some brewers use them."

The fact here affirmed—that malt substitutes are very commonly employed in the brewing of beer in European countries, and even in Germany, where, according to the veracious writer of the *Sun* article, the people know what good beer is, will be found recorded in every work that treats of brewing. Rudolph Wagner, for example, in his "Hand-Book of Chemical Technology," which is everywhere recognized as an authoritative work, says on this point: "In some of the North German States, potato sugar and syrup" (that is, the meanest kind of glucose, and not to be compared with the admirable product made from corn in this country) "are much employed in brewing, sometimes supplying a third part of the malt." Further on the same author adds: "Potatoes, rice, maize, corn, glycerine and potato or starch sugar are employed in some modern breweries." Bolley, in his treatise on brewing, makes similar allusion to the very common practice of employing malt substitutes by the German brewers.

These authorities, or either of them, would be sufficient to dispose of the misleading statement that the practice of employing malt substitutes is of American origin. On general principles, likewise, such an assertion would appear to be incredible. Almost all we know of the art of beer brewing in this country, we have derived from German sources, and nine out of every ten breweries in the country are owned and conducted by Germans, who would naturally follow the very methods they were familiar with—namely, those practiced in the Fatherland.

Another point, over which the writers of the *Sun* and the *Times* grow quite excited, is that of the wholesomeness of beers produced from such mixtures. They do not dwell upon the evil consequences of using unmalted grains, for the reason, probably, that they were unaware of the fact of their use, or could not strain a point to show their unwholesomeness, if they were; but they throw all their energies into the task of picturing the direful horrors that attend the consumption of beer made with the addition of glucose or corn sugar. Though we effectually disposed of this ridiculous piece of sensationalism in our earlier allusion to the subject, we think it will be of interest to our readers to hear what the brewers themselves have to say about it. We quote, therefore, from the same communication to Commissioner Raum, the following, bearing on the subject:

"There is nothing deleterious in the addition of more farinaceous matter. It is accompanied by the same albuminoids, extractive matter and mineral salts, and merely produces the desired variations of color and flavor. In regard to artificial glucose, this and its operation are apparently misunderstood. We do not believe that any brewer uses it in quantity. They prefer to trust to the glucose in the malt for the strength of the beer; but when the wort becomes weakened at the last drawing, some may regain the required density by the addition of a small quantity of glucose, until the saccharometer indicates a sufficiency, rather than run the risk of discoloration, or of affecting the taste and flavor, through gaining the same density by long-continued evaporation. The glucose used is pure in every way, being the same that is used on the brewer's own table and throughout the country under the name of 'drips,' 'golden syrup,' etc. But harmless as it is, it is rarely practiced."

When newspaper reporters take a hand at science, they run the serious risk of getting things mixed up. But when one of this omniverous fraternity makes up what he calls his mind, to venture it, he usually pitches in regardless of consequences, trusting to his imagination, to supply whatever dearth of such trifles as facts, that he may encounter. No better illustration of this could be desired than is afforded by the utterly baseless denunciation of American brewers that lately appeared in the columns of the two newspapers we have named.

The brewers' committee pointedly say in conclusion: "Every modification and improvement of a manufacturing process in the interest of science and progress seems destined to meet with like clamor, just as men predicted untold evils from gas and railroads; but as the real nature of the innovation comes to be understood the clamor dies out, to be revived by some object farther on."

New Publications.

Hubbard's Newspaper and Bank Directory of the World.

This admirable and exhaustive work covers so much ground, and presents such a variety of information on every subject even remotely connected with its title, that one does not know whether to be more surprised at the enormous industry and patience of its author, than gratified with the comprehensiveness, accuracy and wealth of its information. We give below a general idea of its scope and character, though the space we can devote to it permits us to do but feeble justice to its merits.

The work is published in two volumes, of about 1,300 pages each, fully and admirably illustrated, and printed upon elegant tinted paper in the most irreproachable style. The binding is handsome, and the lettering with titles in English, French, German, Spanish and Chinese.

The most important portions of the contents of Volume I. are the "Story of the Types," by Henry Clay Lukens, which gives a most interesting epitome of the rise and progress of printing and journalism; and the lists of American and Canadian newspapers, which are arranged alphabetically by States and Territories, and are very full, giving evidence of having been prepared with care and thoroughness. In addition, Volume I. contains a series of descriptive articles on the United States, and of its various States and Territories, a number of maps, giving counties and names of towns, cities, railways, rivers, etc., together with tabulated statistics of areas, population, etc.

Volume II. is devoted largely to the lists of newspapers of foreign countries, to which 820 pages are devoted, the lists being claimed to be more complete than any that have heretofore been prepared. Following these, come a series of gazeteer articles descriptive of foreign countries, and a series of maps of foreign nations, etc. "The Responsible Banks of the World" is the title of a list embracing about 20,000 banks, and covering some 200 pages. Other subjects of interest in the volume are on the Growth of the Press of the United States from 1850 to 1880, giving a large amount of statistical information respecting journalism, "boiled down;" an "Exhibit of the Newspaper Publications of all Nations," and kindred topics, given in English, French, German and Spanish.

In closing our brief notice of this unique and comprehensive work, we give the following facts of general interest, which we glean from its pages: Hubbard's world's list comprises 34,274 newspapers and periodicals, with a circulation of (in round numbers) 116,000,000 copies, the annual aggregate circulation reaching 10,592,000,000 copies, or about 6½ papers per year to each inhabitant of the globe. Europe leads with 19,557, and North America follows with 12,400; Asia has 775; South America, 699; Australasia, 661; and Africa, 132. Of these journals, 16,500 are printed in the English language, 7,800 in German, 3,850 in French, and over 1,600 in Spanish. There are 4,020 daily newspapers, 18,274 tri-weeklies and weeklies, and 8,508 issued less frequently. It appears that while the annual aggregate circulation of publications in the United States is 2,600,000,000, that of Great Britain and Ireland is 2,260,000,000.

We can endorse the opinion of one of the numerous reviewers of this work, who says of it that it is "a directory, a magazine, an encylopædia, a typographical and biographical dictionary and atlas all in one."

Man's Origin and Destiny, Sketched from the Platform of the Physical Sciences. By J. P. Lesley. Second edition, enlarged. Boston: George H. Ellis. 1881. Pp. 442.

The major portion of the present work was originally prepared as a series of lectures, delivered at the Lowell Institute in Boston, in 1866, and published two years later in a volume bearing the above title; it has since been republished in a second edition, with the addition of six new lectures. The volume is a most remarkable one in many ways, and no educated reader can take it up without marveling at the wealth of learning possessed by its author, and which he scatters in lavish profusion throughout its pages. The book is marked, too, with the impress of the author's strong individuality, and abounds in original thoughts and views bearing upon the subjects discussed.

A New Odontograph.—From Knox & Shain, 724 Chestnut st., Philadelphia, we have received a new "Odontograph" or pattern-maker's and millwright's assistant, which enables any one using it, whether or not he has any knowledge of mathematics, to lay out gear teeth which are not only strong and free from backlash and undue friction, but have the great merits of being interchangeable and having for outlines only circular arcs. There are gear teeth with circular arcs, which are equally easily made, but this instrument gives teeth having only circular curves, and yet working together with the precision of epicycloids. The manufacturers will send one postpaid to any address for $1.

OTHER PUBLICATIONS RECEIVED.

Constitution, Rules and Regulations and By-Laws of the Mechanics' Exchange of the City of St. Louis.

Labor, Wages and the Tariff. Remarks of Hon. Abram S. Hewitt, of New York, delivered in the House of Representatives, March 30th, 1882.

Annual Report of the Commissioner of Agriculture for the Year 1880. Washington: Government Print. 1881. From Hon. Chas. O'Neill, M. C.

Geological Survey of Michigan, Upper Peninsula, 1873–1880, accompanied by a Geological Map, etc. By C. Romiger, State Geologist. New York: Julius Bien. 1881. From the Board of Geological Survey.

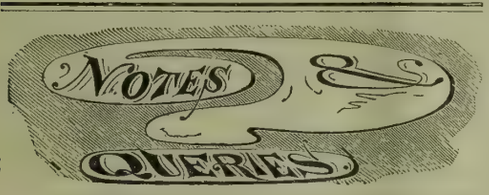
The Successful Maritime Policy. An Investigation into the Causes of the Decline of our Shipping Interest, comprising a speech delivered before the National Tariff Convention; an address before the Committee on Post Offices and Post Roads; and an answer to the Misrepresentations of Mr. David A. Wells. By John Roach, Esq. Published by the Metropolitan Industrial League, New York.

On a Feed-Water Heater and Filter, etc. By George S. Strong, Philadelphia. Reprint from the Proceedings of the Institution of Mechanical Engineers, Newcastle-on-Tyne. From the author.

Second Annual Report of the Women's Silk Culture Association of the United States, for the Year ending April 18th, 1882; and Silk Culture in the United States. By Lorin Blodget. From the Association.

Tenth Annual Report of the Board of Directors of the Zoölogical Society of Philadelphia. Philadelphia, 1882. From the Society.

John Hopkins University Circular, No. 15. This issue of the university circular contains abstracts of numerous important papers read before the university societies, embracing the Scientific Association, Philological Association, Historical and Political Science Association, Metaphysical Club, and Mathematical Seminary; also a synopsis of the more important contents of the several scientific journals published at the university, including the *American Journal of Philology*, the *American Journal of Mathematics*, and the *American Chemical Journal*; together with other matter of scientific interest. The university has already made for itself a high reputation as a center of original research.



This department is intended to furnish, for the benefit of all our readers, information on any subject of a scientific or technical character falling within the field of THE MANUFACTURER AND BUILDER. *Any of our readers possessing additional or more correct information than that which we give relating to the questions, are cordially invited to communicate it to us for publication. We also request that all questions or answers be written on separate pieces of paper, and addressed to the Editor.*

QUESTIONS.

(3028) QUIETING TURBULENT WATER WITH OIL.—Is there any truth in the popular belief that oil smooths troubled waters? If so, why is not oil made use of by mariners when in danger?—R. S., Boston, Mass.

(3029) SAFE COLORED FIRES.—I read your explanation of the explosion of blue fire in your May issue with great interest. Can you give me a receipt for making colored fires that will be safe against spontaneous combustion or explosion?—A. F. S., Philadelphia.

(3030) FLOATING THE BODY IN WATER.—I have seen the statement made in a scientific journal that the human body is lighter than water, on which account, if one should throw oneself on the back in water, the body would float without muscular effort. Now, I do not question the accuracy of the statement that the body is lighter than water, but I do question the possibility of its remaining in a horizontal position in water without some muscular effort. I have often tried the experiment of floating, and have found that lying perfectly still on the water for a few seconds, my feet commence to sink and my body would take a vertical position in the water. I would ask you if there is not some mistake in this assertion about floating?—A. T., Vicksburg, Miss.

(3031) BOILING POINTS OF VARIOUS LIQUIDS.—Where can I find a table of boiling points of liquids?—J. M. B., Schenectady, N. Y.

(3032) GLASS WEIGHTS.—Why could not weights for fine analytical work be made of glass? It seems to me that they would have many advantages over the metallic weights now used, and would be cheaper.—T. S. D., Chester, Pa.

(3033) WALNUT STAIN FOR WOOD.—Please give me a good receipt for a dark walnut stain for wood.—B. F., Worcester, Mass.

(3034) IMITATION EBONY.—What is the best mode of staining wood in imitation of ebony?—B. F., Worcester, Mass.

(3035) PORT OF NEW YORK.—Is not New York the most important port in the world? I mean in respect to the amount of its annual tonnage?—A. J. M., New York.

(3036) SOLUTION FOR MENDING BAND SAWS.—I have been a reader of your journal since the first year of its publication, and now ask my first question. There is a process for mending band saws in use here, and I would like to have the recipe. The solution used shows a white precipitate which about half fills the bottle; on the top is a clear liquid. Before using it, it is shaken up, when it has the appearance of milk. The saw is moistened with it, and a stick of solder melted and dropped on the surfaces to be joined; they are put together and heated with a spirit lamp until the solder melts, then clamped with a cold tongs, and it is complete. I enclose a sample of the solder, and it would oblige me very much if you will give a formula for preparing the solution and solder.—A. G. S., Lawrenceburg, Ind.

(3037) RECIPE FOR INK.—Will you please give a recipe for a good black ink, for school use, that will not be injured by freezing, and that can be made cheaply and readily. Since most schools use large quantities of ink, by answering the above you will help many teachers, who find it difficult to make an ink that will stand freezing.—J. B. G., Jackson, Mich.

(3038) LOAD SUDDENLY APPLIED.—I have noticed the statement that where a strain is suddenly applied to a piece of metal, it will break much below its usual limit of strength. What is the reason of this? It appears to me that if the metal has a certain strength it should show it under all circumstances.—G. M. E., Elkton, Md.

(3039) TENSILE STRENGTH OF METALS.—Are the tables of the tensile strength of different metals, as given in engineering text-books, reliable? I notice, in comparing some of the figures given in different books, that there is a wide variation in some of the values.—G. M. E., Elkton, Md.

(3040) CEMENT STOPPING FOR WOOD.—What is the best mode of stopping up flaws or cracks in wood-work, that is varnished or japanned?—W. C. D., Rochester, N. Y.

(3041) TO MAKE PARCHMENT TRANSPARENT.—Please inform me of a good way to make parchment transparent.—W. W., Pottsville, Pa.

(3042) SOLDER FOR ZINC CASTINGS.—What is the best solder for uniting zinc castings?—S. J. H., Binghampton, N. Y.

(3043) ARCHITECTURAL AND BUILDING JOURNAL.—Will you please inform me if there if there is a paper or journal similar to the MANUFACTURER AND BUILDER, entitled the *Architect and Builder?* If so, where published, and under what title?—A. D. J., New Albuquerque, N. M.

REPLIES.

(3027) GRISCOM'S ELECTRIC MOTOR.—In our June number we inadvertently gave the President of the Griscom Motor Company of Philadelphia, as Wm. Harding, whereas the President is W. W. Griscom, at the office of the company, 121 South Third street.

(3028) QUIETING TURBULENT WATER WITH OIL.—It is undoubtedly true that oil possesses, to a wonderful degree, the power of quieting the violence of turbulent water. The fact has been observed and known from the most ancient times, and "pouring oil upon troubled waters" has for generations been the household synonym for peacemaking. Pliny records the fact that "all seas are made calm and still with oyle, and therefore the dyvers do spurt it abroad with their mouths into the water, because it dulceth the unpleasant nature thereof, and carryeth a light with it." And Gordon Cumming, the well-known traveler, records as a remarkable confirmation of these words, the fact that the divers of the Mediterranean actually do, at this day, spurt oil in the manner described by Pliny, in order to clear the light under the surface of the water by the surface stillness it causes. He records also that the hardy fishermen of the Shetland Islands constantly avail themselves of the soothing power of oil when in danger of being swamped by the furious tempests that frequently overtake them. They cut open their fish (chiefly cod and ling) tear out their livers, and after crushing them to free the oil they contain, throw them overboard in every direction, "and immediately, as if by magic, the mad raging of the waters is allayed." Franklin is credited with the observation that whenever whaling vessels were lying in Newport (Mass.) harbor, the water was always smooth, on account of the leakage of blubber. He also made some experiments himself to verify the fact, by pouring oil upon the surface of a large pond when it was strongly agitated, and with satisfactory results. He afterwards repeated the same experiment on a larger scale in the surf at Portsmouth, N. H. "Selecting a tempestuous day, he sailed out half a mile from shore, and poured a moderate quantity of oil on the tossing waters. The effect was instantaneous, for, although the swell continued, the surface was not wrinkled or broken, and though the sea around was white with crested waves, there were none in the smooth track left by the boat; and he noticed that a barge rounding the headland under sail at once turned into the oily path as on to a turnpike." The same writer we have previously quoted (Cumming), in an article on this interesting topic, records quite an array of accounts and statements of ship captains and others confirmatory of this remarkable stilling action of oil, in many of which the saving of vessels and their crews is unhesitatingly ascribed to it. The explanation of this singular action of oil is probably that it offers far less resistance to the rapid movement of air over its surface than is offered by water; the wind, therefore, glides over its surface without seriously disturbing it, spreading it out over a large area. A trifling quantity of oil, will, in this manner, protect a large body of water. Dr. Franklin found that one teaspoonful produced an instant calm over a considerable space, and, spreading rapidly, soon made an oily film over an extent of at least half an acre, which became as smooth as a looking-glass. One drop of oil forms a film of about four feet in circumference. It is somewhat singular, after so many convincing evidences of the truth of this ancient observation, that no proper effort has been made to systematically utilize it for the saving of life and property. It appears, however, according to Cumming, that Mr. John Shields, of Perth (Scotland), has just introduced a plan for making practical use of the facts here recorded. Mr. Shields is deserving of much credit for taking the initiative in this effort, and if properly carried out, it may be productive of great benefits to life and property.

We add in conclusion a brief abstract of Mr. Shield's experiment, as narrated by Cumming: "It at once occurred to him that it might be possible to apply oil in such a systematic manner as to calm the entrance to a harbor in stormy weather. The idea having once suggested itself, he never rested till he had thought it out and devised means of executing it. The plan he hit upon was that of laying iron and lead pipes from the beach, right out across the harbor, to the open sea, terminating in the deep water, two hundred feet beyond the bar, and then, by means of a force pump on the shore, to pump oil into the tubes, and eject it at the bottom of the sea, outside the harbor, so that as it rose to the surface it might be driven inward and prevent the formation of breakers on the bar. The pipes are fitted with three conical valves, fixed 75 feet apart at the sea end of the pipe. These are forced open by the stream of oil as it flows out, and instantly close when the pressure is removed. Mr. Shields fixed upon Peterhead, in Aberdeenshire (the easternmost headland of Scotland, and consequently a spot exposed to the full force of every gale that sweeps the east coast), as the most suitable spot for his test experiments. Here, then, he proceeded to submerge 1,200 feet of lead and iron piping. A large barrel containing about a hundred gallons of oil was placed in a shed on the beach, in connection with the force pump. No better day could have been selected to test the soothing power of oil. If any perceptible difference could be produced on those raging, tumultuous waters, it was evident that the gaining of a complete mastery over them became merely a question of how much oil was to be expended. In the present instance the big hundred-gallon cask was filled. The forcing pump was set in action, and a large quantity of oil was driven through the pipes, whence it was ejected at the bottom of the sea, at some distance beyond the impassable barrier of mighty breakers. The oil immediately rose to the surface, and formed a thin film on the water, extending right across the harbor mouth. Straightway the dangerous white crests disappeared, and, though the strong tide still swept inward in huge swelling billows, they were shorn of their terror, and became perfectly smooth rollers, on which any vessel or boat might safely have ridden into dock." It is of course questionable whether in a gale of considerable severity the quantity of oil required to effectively perform its office, would not be so great as to render the introduction of the plan for the protection of harbors impracticable on economic grounds. On this point, as upon others, concerning which practical objections may be raised, we must wait for further information before approving or condemning it. For vessels and boats in danger of swamping in tempestuous seas, however, there can be no question that the judicious use of this simple remedy may often save them from what would otherwise be inevitable destruction.

(3029) SAFE COLORED FIRES.—As the dangerous character of the mixtures for producing colored fires resides in the use of chlorate of potassium and sulphur, any formula intended to lessen the tendency of such mixtures to accidental ignition, must dispense with the use of those substances. Herr Sailer, of Altstaetten, Switzerland, has called attention to this very fact, and emphasizes a number of precautions to be taken. He points out that unless the materials commonly employed in preparing these mixtures are very pure, and the mixtures made with every precaution, they are liable to spontaneously ignite or explode. He recommends the following mixtures as absolutely safe. He adds that they do not produce quite as handsome a light as those containing sulphur, but asserts that they are still quite satisfactory, besides having the advantage of burning without much smoke and poisonous vapors:

For Red Fire.

Shellac	1 part.
Nitrate of strontium	5 parts.

For Yellow Fire.

Nitrate of sodium, pure and dry	1 part.
Shellac	4 parts.

For Green Fire.

Shellac	1 part.
Nitrate of barium	5 parts.

The shellac should be fused with the color-producing salt, which should be as pure as possible, and the resulting mass should be preserved in tight tin boxes. Following out the same general method, we should presume that the following receipt for blue fire would answer quite as well as the others:

For Blue Fire.

Nitrate of potassium	3 parts.
Ammonia-nitrate of copper	3 "
Shellac	1 part.

(3030) FLOATING THE BODY IN WATER.—The trouble with this inquirer is very easy to understand. The statement is strictly true that the body may be supported indefinitely on the surface of water (fresh or salt) without the least muscular effort. But to do this, the body must be properly balanced, else the feet will sink. When, as our inquirer has probably done in his experiments, the hands are held down by the sides in floating, the lower portion of the body is made so much heavier than the upper portion, that it is in a position of unstable equilibrium, and stable equilibrium is not attained until the body has assumed the vertical position, in which it will remain. If, however, the body in the

position of flotation, is properly balanced, as by extending the arms at right angles to the body, or, better still, by interlocking the fingers and placing the hands beneath the head, thus throwing a considerable weight into the upper half of the body, the body will float without the slightest muscular effort as long as the person chooses to remain in this attitude. We have no doubt that persons who are very fat will find no difficulty in floating without motion, even with the hands down at the sides; but with persons of ordinary build the case is different. These explanations, we believe, will answer our inquirer's question satisfactorily.

(3031) Boiling Points of Various Liquids.—By referring to any standard work on natural philosophy, this inquirer will find tables of the boiling points of various liquids, such as alcohols, ethers, acids, oils, saturated salt solutions, etc. We add a few at random, for his information, hoping they may be of service to him. The degrees are those of Fahrenheit's scale:

Ether	96	degrees.
Carbon di-sulphide	113	"
Alcohol, specific gravity 813	173.5	"
Nitric acid, spec. grav. 1.42	247	"
Water	212	"
Muriatic acid, spec. grav. 1.09	232	"
Oil of turpentine	316	"
Sulphuric acid, spec. grav. 1.848	600	"
" " " 1.810	473	"
" " " 1.780	435	"
" " " 1.700	374	"
" " " 1.650	350	"
" " " 1.520	290	"
" " " 1.408	260	"
" " " 1.300	240	"
Linseed oil	640	"
Whale oil	630	"
Mercury	662	"
Saturated Aqueous Solutions.		
Chloride of calcium	285	"
Acetate of soda	256	"
Nitrate of soda	246	"
Rochelle salt	240	"
Saltpeter	238	"
Muriate of ammonia	236	"
Tartrate of potassa	234	"
Sea salt	224.5	"
Common salt	224	"
Sulphate of magnesia	222	"
Borax	222	"
Sulphate of soda	222	"
Carbonate of soda	220	"
Alum	220	"
Chlorate of potassa	218	"
Sulphate of copper	216	"
Sugar of lead	215.6	"
Glauber salt	213.3	"

(3032) Glass Weights.—There are certainly some good reasons to be urged in favor of making fine weights of glass, or something resembling it. They can be readily made, and would be practically unalterable. Glass, however, is hardly the right material. Rock crystal—pure crystallized quartz—would be much better than glass for this purpose, for the reasons that quartz is much harder than glass, and hence not liable to be scratched and abraded by contact with hard substances when in use; and because it is also on this account less liable to be broken or chipped by rough usage or accident. The advantages of rock crystal for weights have been already perceived, and they have been made and used with very satisfactory results. They are made at Oberstein, famous for its agate cutting and polishing industry, and are referred to in the "Annual Record of Science and Industry" for the year 1875, in the following terms: "The considerable hardness of the rock crystal protects the weights from abrasion by usage, to which objection all weights of metal are open. The rock crystal is even more indifferent to the action of acids and alkalies than platinum, while it is utterly indifferent to oxidation, to which weights of metal are all more or less liable. Moisture has no effect upon it, since it is not hygroscopic. As compared with the metals, rock crystal has a very small coefficient of expansion, on which account the errors arising from variations of barometer and thermometer are reduced to a minimum (this point refers specially to standard measures of rock crystal). The weights are not objectionable on the score of expense, their cost being quite moderate. As made at Oberstein, by Herr Stern, the larger weights, from 50 grams to 1 gram, are made of rock crystal, the pieces having substantially the same form as the commonly used weights of gilded brass. The smaller weights are made of platinum as usual. Fresenius, who has used these weights, speaks well of them, declaring them to be admirably adapted for analytical work." It is only necessary to add, in conclusion, that weights of this or similar materials require to be handled and used with unusual care, to preveat breaking or chipping them. Aside from this disadvantage, the rock crystal weights are all that could be desired.

(3033) Walnut Stain for Wood.—The following formulas for staining wood in imitation of walnut will doubtless answer this inquirer's purpose: 1. Take asphaltum, pulverize it, place it in a jar or bottle, pour over it about twice its bulk of turpentine, put it in a warm place, and shake it from time to time. When dissolved, strain it and apply it to the wood with a cloth or stiff brush. If it should make too dark a stain, thin it with turpentine. This will dry in a few hours. If it is desired to bring out the grain still more, apply a mixture of boiled oil and turpentine. This is better than oil alone. Put no oil with the asphaltum mixture, or it will dry very slowly. When the oil is dry, the wood can be polished with the following: Shellac varnish of the usual consistency, 2 parts; boiled oil, 1 part; shake it well before using. Apply it to the wood by putting a few drops on a cloth and rubbing briskly on the wood for a few minutes. This polish works well on old varnished furniture. 2. The appearance of walnut may be given to white woods by painting or sponging them with a warm concentrated solution of permanganate of potassa. The effect is different on different kinds of timber, some becoming stained very rapidly, others requiring some time for the result. The permanganate is decomposed by the woody fiber, brown peroxide of manganese is precipitated, and the potash is afterwards removed by washing with water. The wood, when dry, may be varnished.

(3034) Imitation Ebony.—We have given several answers to substantially the same question as this, in previous numbers, but give the following for the information of this inquirer: Wash any compact wood with a boiling decoction of logwood three or four times, allowing it to dry between each application. Then wash it with a solution of acetate of iron, which is made by dissolving iron filings in vinegar. This stain is very black, and penetrates to a considerable depth into the wood, so that ordinary scratching or chipping does not show the original color of the wood. It is a mistake to mix the solutions of logwood and iron before applying them to the wood, as some recipes direct.

(3035) Port of New York.—To this we answer, No. From the latest information we have at hand, Liverpool ranks as the most important port in the world, with a tonnage of 2,647,373; London stands second, with 2,330,688 tons; Glasgow third, with 1,432,364 tons; and New York fourth, with 1,153,676 tons. The nine leading ports of Great Britain have a tonnage of 8,724,123, and the first four ports of the United States a tonnage of 1,976,940. Great Britain and Ireland possess a tonnage of nearly 12,000,000; and, including the colonial vessels, the British flag covers 14,000,000 of the total existing tonnage of the world, which is estimated to be 27,000,000. The United States twenty years ago carried 66 per cent of its foreign trade in its own vessels, but now only something like 10 per cent.

(3036) Solution for Mending Band Saws.—The liquid mentioned by this inquirer is most probably borax water, which is commonly used for soldering and brazing. It is made by burning a quantity of borax on a hot shovel or piece of sheet iron, or in an iron dish, then pulverizing and mixing with enough rain water or condensed water to form a creamy liquid. It would be impossible for us to give the composition of the solder without making a chemical analysis. It is probably a silver solder or fine spelter solder. The first could be made by melting together 2 parts (by weight) of silver and 1 of brass; and the latter by taking 77.5 parts of brass, 20.5 of zinc, and 2 of tin. We think these proportions would give satisfactory results. We give in what follows some formulas for joining band-saw blades, that may, in connection with the foregoing, be of use to this correspondent. From "Grimshaw on Saws" we take the following: "File the ends of the saws on opposite sides to form two wedge-shaped ends, having a lap of say from ¾ to 1½ inches, according to the width and thickness of the plate; a thin, narrow blade for light work, like ordinary scroll sawing, ¾ inch; a wide saw, say 4 or 5 inches in width, by No. 16, 17 and 18 gauge, 1½ inches lap. When the two beveled sides are laid together they should form a good joint of the same thickness as the blade. Now, take two pairs of tongs with heavy jaws, long enough to cover the width of the blade; the jaws should be straight and shut closely. Cut a notch in a piece of about 6×6 joist for wide saws, and smaller for narrow saws; have the notch large enough, and covered or plated inside, so that it will not be burned by the hot tongs. Next clamp the saw on the joists so that the laps will come over the notch. The joists should be say 4 feet in length, and mounted on legs like a carpenter's saw horse. Now cover the lap with muriate of zinc (made by feeding muriatic acid with all the zinc fragments it will dissolve) or borax water, placing a piece of very thin silver solder or fine spelter solder in the joint. If spelter is used, it may be mixed with borax water and spread between the joints (silver solder, however, is preferable to spelter). Now heat one pair of the tongs to a bright cherry-red, and scrape off all the scale, etc., between the jaws; clamp the joint to be brazed, using another pair of cold tongs to clamp the points of the hot tongs; hold them a sufficient length of time to melt the solder, and have the other pair of tongs warmed to about the heat of a sad-iron. Now carefully draw the hot tongs off towards the back of the saw, having the back rest firmly against supports so that the saw cannot move edgeways. Have another person follow up the hot tongs with those merely warmed; hold the grip with the warm tongs until the joint is fairly set, when nothing remains to be done except to file off the superfluous solder. The above process will be found much better than cooling off the joints with water, which is liable to harden and crack the blade. The soldering and cooling tongs should be made heavy and strong. The cooling tongs should not be used entirely cold, as the sudden chilling will harden the blade. If the process is properly performed, the saw will be of the same temper at the splice as in other parts." Messrs. London, Berry & Orton, of Philadelphia, print the following directions for joining their band saw blades: The ends of the blade should be filed to give a new surface, scarfing to about one-half at the ends, making the lap from ½ to ¾ inch long, according to the width of the blade. Wash the surfaces clean with muriatic acid, put a piece of silver solder in the joint, and clamp the joint with a pair of soldering tongs heated to full red heat. Observe the solder and see that it runs; draw the tongs off, following with a wet sponge to cool the blade and restore the temper. After joining, file down the saw to the proper thickness. It is well to take the set out of the saw before making the joint, and observe that the back of the saw is straight and fits well against the frame, to which it must be clamped in the operation.

(3037) Recipe for Ink.—We know of no ink that will not be injured more or less by freezing, consequently cannot meet this inquirer's request. The best that we can do is to give him a standard receipt for ink that we have verified in practice and found to give excellent results. Boil in 1 gallon of water 1 pound of bruised Aleppo galls for two hours, adding water to make up for the loss by evaporation. When cold, strain off the liquid portion. Dissolve 5 ounces of sulphate of iron (green vitriol) in as little water as possible, assisting solution by heating; also dissolve ¼ pound of gum arabic in as little water as possible. When the solution is complete, pour the iron salt and gum into the decoction of galls with constant stirring. The ink should be allowed to stand in an open vessel for several days before it will be sufficiently dark for use, then transferred to a tall bottle and kept well stoppered. To prevent the tendency of this ink to clot, especially if placed where it is liable to freeze, the addition of a small quantity, say half a wineglass of vinegar, may be found serviceable.

(3038) Load Suddenly Applied.—The statement noticed by this inquirer is strictly correct. The strain which a piece of metal, or of any other substance, can sustain without rupture, varies greatly according to the manner in which the strain is applied. If a piece of metal receives its load suddenly, it will break under a less weight than if the load comes on slowly and gradually increases. The difference can amount to as much as twenty per cent. When the load is applied slowly the particles of the metal have time to receive the strain and to transmit it from one to another, and thus to divide the strain equally between them, the result being that in this manner the maximum strength of the metal is brought out. When the load, however, is applied suddenly, the suddenness of the shock received allows no time for the transmission of the strain from particle to particle, and the result is fracture or rupture under a load which the metal could easily have withstood if applied slowly.

(3039) Tensile Strength of Metals.—If this inquirer will consult the authorities who are acknowledged by the engineering profession to be reliable, he will find that they will not vary materially from each other in their values of the tensile strength of metals. As reliable authorities we may name Trautwine, Nystrom and Haswell, whose pocket-books may be consulted. On this particular subject, Kirkaldy, an English authority, is eminent. It is not to be expected that the figures of the tensile strength of metals given by different authorities should exactly correspond, since this factor is modified by many circumstances, such as differences in purity, differences in physical condition, whether hammered, rolled, cast, etc. Indeed, pieces cut from the same bar may, and occasionally do, show notable differences. The best, therefore, that can be expected of such figures, is that they shall represent the average strength of average samples.

(3040) Cement Stopping for Wood.—Convert a quantity of sawdust, of the same kind of wood as that of the work, into pulp, by boiling and lengthened immersion in water. When quite soft and pulpy, strain off the water through a cloth, and squeeze the moisture from it; keep this for use, and when wanted mix a sufficient quantity of thin glue to make it into a paste; rub it well into the cracks, or fill the holes with it. When it is quite hard and dry, it may be cleaned off and finished. If the work has been carefully done, the patches will hardly be detected.

(3041) To Make Parchment Transparent.—Soak a thin skin of parchment in a strong ley of wood ashes, wringing it out frequently, until it appears transparent enough; then strain it on a frame and let it dry. This will be much improved, if, after it is dry, it is given a coat, on both sides, of clear mastic varnish diluted with spirits of turpentine.

(3042) Solder for Zinc Castings.—A good solder for uniting zinc castings, according to Overman, is composed of two parts of tin and one of zinc. The surfaces to be united are freed from oxide preparatory to using the solder, by the application of either muriatic acid or chloride of zinc.

(3043) Architectural and Building Journal.—There is journal published in Boston, Mass., called the *Architect and Building News*. This we presume is the one you have reference to. The publishers are James R. Osgood & Co.

THE MANUFACTURER AND BUILDER,
A PRACTICAL JOURNAL OF INDUSTRIAL PROGRESS.

Vol. XIV.—No. 8. AUGUST, 1882. Fourteenth Year.

Improved Pumps for Special Service.

We illustrate herewith and describe certain improved pumps, each specially adapted, by reason of important modifications of mechanical construction, for the particular duty for which it has been designed. They are from the extensive establishment of the George F. Blake Manufacturing Co., 88 Liberty street, New York, and 44 Washington street, Boston, and represent in their design and construction the most recent improvements introduced by these enterprising manufacturers.

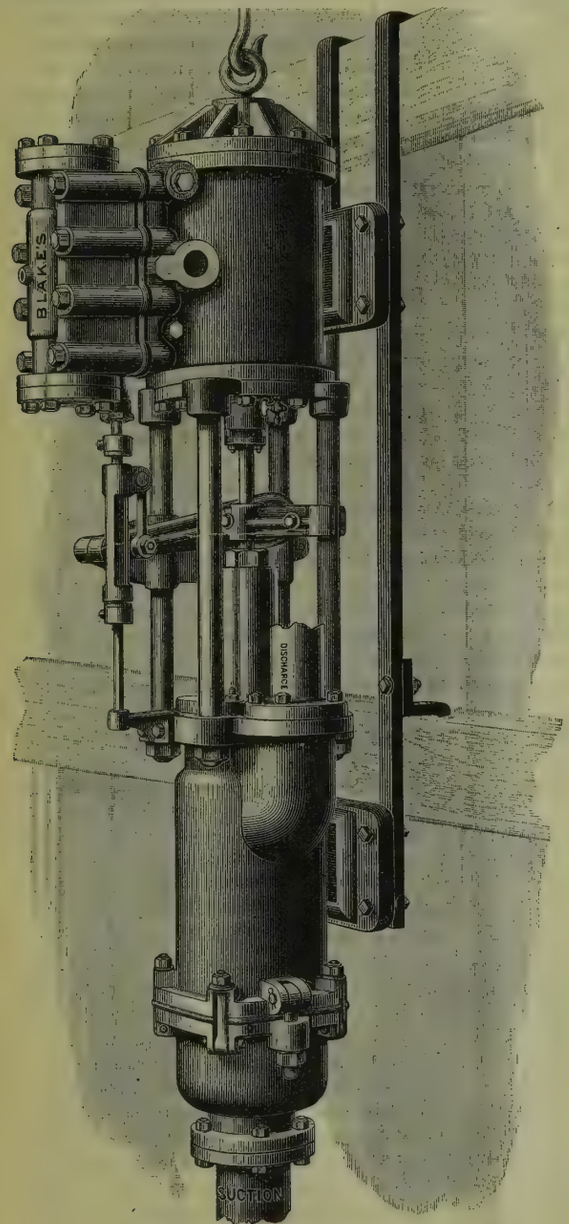


Fig. 1.—NEW SINKING PUMP.

Fig. 1 of our illustrations represents the improved sinking pump of these manufacturers, of vertical double-acting plunger pattern, designed especially for sinking new shafts, recovering old mines that have been "drowned out," and for mining operations generally, requiring the use of a light, portable and efficient steam pump; also for sinking wells and general excavation work. The vertical form of this machine permits of its introduction into the shaft without taking up much room, which may often be an important feature of convenience. It is provided with a ring-bolt firmly imbedded in the upper steam cylinder head, which is webbed to give extra strength. To the ring-bolt, tackle for raising and lowering the pump can be readily attached. Adjustable wrought iron dogs are firmly bolted to the cylinders, by which the pump may be hung at any desired hight to the shaft timbering.

The peculiarity of this pump which distinguishes it from others of the same class, lies in certain important details of the arrangement of its water cylinder. The arrangement referred to, is such that while the water cylinder has but one plunger, the pump is practically double-acting in operation. To accomplish this object, the plunger is made of such shape as to give it two effective pumping areas. For this purpose the lower end of the plunger is enlarged, and works in a cylinder lined with a patent removable bushing of hard composition, and is packed with Tuck's fibrous packing. This end of the plunger contains the delivery valve, of vulcanized rubber. The upper part of the plunger works through an ordinary stuffing box, packed from the outside. Ports of sufficient area are let into the plunger above and below the delivery valves; the suction valves are in the lower section, near the suction nozzle.

Although, therefore, in the operation of this pump the suction comes into play only at every other stroke, the arrangement of the water cylinder just described, renders the delivery continuous, as in the regular "bucket-plunger" form of pump, the upper part of the plunger serving as an effective air chamber.

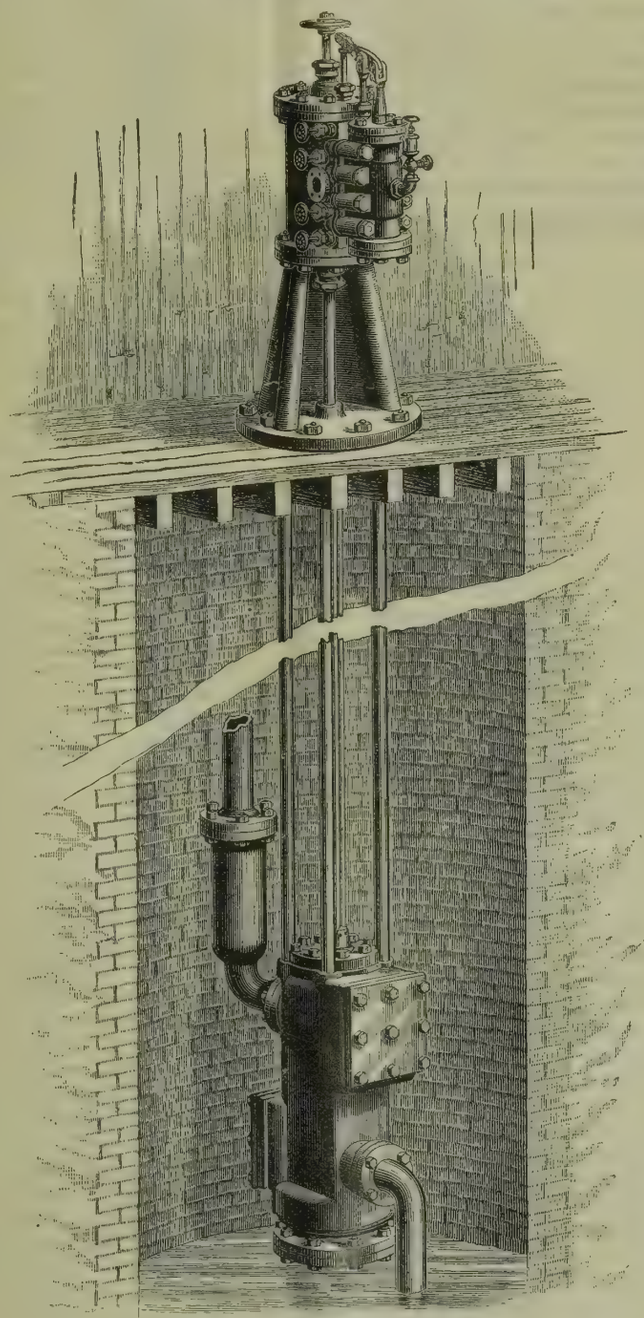


Fig. 2.—IMPROVED DOUBLE-ACTING VERTICAL PUMP—PISTON PATTERN.

The size of the pump just described is as follows: Steam cylinder, 10 inches diameter; upper part of

water plunger, 5 inches diameter; lower part of plunger, 7 inches diameter; stroke, 12 inches. The pump weighs about 1,300 pounds, and has a capacity of 100 to 150 gallons per minute.

Fig. 2 is an illustration of the improved piston-pattern, double-acting vertical pump of the same makers, intended specially for service in deep wells, dry docks, etc. In this form of pump the steam cylinder is arranged upon a strong frame for bolting to the wood-work at the mouth of the well, as shown in the cut.

The water cylinder may be located at any desired depth, the elongated piston rod being provided with proper guides. Pumps of this pattern are running in wells, we are informed, as deep as 190 feet.

The lining, piston rod, stuffing box, valve seats, valve bolts, etc., of the water cylinder are made of the best composition. The water piston is also made of composition, suitably packed.

The design and construction of this pump is simple. It has demonstrated itself to be durable in service, and, in fact, possesses substantially all the improvements that have made the regular horizontal pump of these makers so popular. It is double-acting, and will consequently deliver a continuous stream of water steadily, and without shock or noise.

The George F. Blake Manufacturing Co. will furnish additional details on application to the address given above.

The Manufacturer and Builder.

A MONTHLY JOURNAL

DEVOTED TO THE

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Vol. XIV., No. 8. Fourteenth Year.

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Where is the Future Supply of American Mechanics to Come from?

There was a time, that many who are not past middle age can recall, when American work-shops were filled with American mechanics; but that was when the old apprentice system was in vogue, and when the title of "American mechanic" was esteemed among workingmen as the title of "Roman citizen" was held in esteem in an elder day.

To-day the bearers of this honorable title of distinction are—compared with their numbers and influence not a generation ago—few and far between, because of the gradual decay of the old apprentice system which furnished the educated artisans and skilled craftsmen of a few decades ago.

For this lamentable state of affairs, which has made of the sons of American mechanics, clerks or representatives of other over-filled and under-paid occupations, or, what is still more to be deplored, corner-loungers without occupation, there is no other responsible cause than the detestable trades-union system—an excrescence of foreign growth, that has succeeded, within the brief period named above, in demonstrating its unfitness for existence by extinguishing from the list of American institutions—the apprentice system—the system of all others that originated and nourished into existence the race that any American might feel proud to be numbered among as a member—the race of American mechanics.

The short-sighted policy of restricting the number of apprentices that shall be employed in a shop, by regulating the same in accordance with the number of journeymen employed therein, is, as we have affirmed above, an outgrowth of foreign principles that have been imported into this country, and the sooner it is abandoned the better for both employer and employed. The former class are not the sufferers, for the stimulus of higher wages that this pernicious doctrine brought into life, has always had, and will continue to have, its usual consequence—namely, the importation of foreign workmen to fill, in a perpetual stream, the positions that the sons of American artisans should fill, and would otherwise fill.

Let the remains of the great army of American mechanics that not many years ago was the strength, the glory of the American nation, that made American inventive genius the proverb of the civilized world, take a bold stand against that organized system of self-deception that has filled American work-shops with foreign mechanics, and that without such opposition on their part bids fair to extinguish the race of American mechanics.

The following items from the daily papers will show how things are drifting, and we print them without comment:

"The steamships 'Montreal' and 'Castor' arrived at this port [New York] this morning. The former landed 525 steerage passengers. About four hundred of them were skilled laborers. . . . Twenty carpet-weavers from Leeds were also upon the steamship. The 'Castor,' from Amsterdam, brought over 488 passengers. They were mostly Germans, and a fine lot of immigrants. Some were peasants, but all the principal trades were represented among them, such as painters, masons, house-carpenters, and cabinet-makers." The other item is a despatch from Pittsburg, as follows: "The iron strike is unchanged. At New Castle the employers are negotiating for foreign labor. An employment agent here has received orders to engage from 800 to 1,000 workmen within the next two weeks. He was instructed to select iron workers, machinists, boiler-makers, pattern-makers and blacksmiths."

The Baltimore *Sun*, in a late leading article on Industrial Schools, says: "Boys may be trained in them to useful careers, whereas without such advantages they fall into habits of idleness and dissipation, or betake themselves in excessive numbers to unremunerative clerkships. The real and best industrial schools were those supplied by the old apprentice system, for it trained hands, mind and morals together. If the American mechanics are wise, and are not already outvoted by their foreign associates in the shops, they will re-establish the system they killed in their folly."

An Important National Requirement.

The conflict which is being waged at the time of writing for the preservation of what are called British interests in Egypt, has a lesson to teach and a warning to convey to our people and their representatives. It has taught that the navy and harbor defences of the country are utterly inadequate to protect the rich cities of our seaboards on the east and west from invasion and destruction in the event of a foreign war.

While we fully appreciate the advantages of economy in the national expenditures, there can be no question that the result of a policy that leaves our sea coast practically at the mercy of the first nation with whom we may become embroiled, can only be called by one name—"penny wise and pound foolish." That there is such a thing as an unwise economy, needs only the reading of the facts of the report of the Naval Advisory Board, lately convened by Naval Secretary Hunt, and consisting of fifteen of the most experienced naval officers. This board reported in November of last year that there was most urgent necessity for the immediate construction of sixty-eight new steel vessels of various styles and armaments, at a total cost of $29,607,000.

In support of this conclusion, the board has advanced many reasons that are deserving of the most careful consideration. If this report says the truth, then while this country, in its successful effort to crush out the rebellion, led the way for the complete revolutionizing of the naval armament of every other civilized power, we have made since then no corresponding improvements in our own, but have allowed other nations to make vast improvements in their navies and guns, supremely indifferent to the fact that in the event of a foreign quarrel, our seaports would be practically defenceless against the attacks of powers whose magnitude, population and material resources are vastly inferior to ours.

One of our daily contemporaries, whose views are entitled to great respect, makes the striking point that "if the views of the Naval Advisory Board, of our Committee on Naval Affairs, and of our Secretary

of the Navy, are not rank idiocy, then it would be in the power of the little State of Chili, in the event of war with the United States, to sail up to the city of San Francisco, and in one day to destroy in that city ten times the value of the whole appropriation of $30,000,000 asked for by the naval experts who have made inquiry into our naval needs. Our four unarmored wooden vessels in the South Pacific squadron —namely, the 'Pensacola,' 'Alaska,' 'Lackawanna' and 'Adams,' would be powerless even to run away from the three European-build ironclads of Chili, still less to fight them."

In view of these humiliating facts, it would seem inconceivable that Congress should adjourn without making liberal provision for a cause that is so imperatively demanded by every dictate of common prudence and common sense, and by that feeling of jealousy for the national honor that every self-respecting American possesses. Yet, if the daily papers correctly report the attitude of Congress towards this vitally important subject, it would appear probable that the total sum which will be appropriated to the Bureau of Naval Construction, will be less than $2,000,000, of which sum less than half will be applicable to the object of beginning the work of constructing new war vessels. When it is stated that the first essential to the fabrication of such guns as the English fleet lately turned on the Egyptian forts, is a monster trip hammer that is estimated to cost $1,000,000, the extent to which the meager allowance above named will go towards the important national requirement of a powerful navy for defence, will be apparent.

Where private interests are to be subserved, such as the improvement of fish-ponds and the like, it would seem to be impossible for the average Congressman to direct his thoughts to the comprehension of subjects of national importance.

We can only hope and trust that the peace which the country has enjoyed and prospered under of late years, may not be disturbed by foreign complications, until we shall have succeeded, in the course of time, in perfecting a naval armament that will not only be adequate to defend our sea-board cities against all comers, but which will be competent to worthily represent and sustain the greatness of the American nation whenever and wherever it shall become necessary.

Our readers may rest assured that we would not depart from our usual course of discussing matters relating to manufactures and the arts, were it not from an impelling sense of duty, and from the conviction that the pictures painted by the daily press of the defenceless condition of the country were is no wise exaggerated. We cannot hope to be so fortunate as to always remain at peace, and in view of the facts above narrated, it devolves on every journal to do what it can to expose and correct them. We commend the following observations from the Chicago *Inter-Ocean* as confirmatory of opinions here advanced:

"Great Britain has forty-one steel and iron vessels of from 3,000 to 9,000 horse-power, and capable of from 12 to 17 knots an hour, of which the 'Inflexible,' 'Dreadnaught,' 'Thunderer,' 'Devastation,' 'Agamemnon,' 'Temeraire,' 'Ajax,' 'Monarch,' 'Neptune,' 'Colossus,' 'Majestic' and 'Conqueror' are turret ships. We have no steel vessels, and but fourteen ironclads fit for service, no one of which has more than three rifled guns, being mostly supplied with smooth bores. Whether we would, in the event of war with England, have any land fortifications capable of stopping such a fleet from sailing up the bay of New York and laying the commercial metropolis of America in ashes, is a question too serious even for speculation. It is certain, however, that we have absolutely no naval defences that could defend a single port for an hour against the fleet which burned Alexandria.

"In 1864, English and French naval officers marveled at our 11-inch Dahlgren gun, weighing 8 tons, on the 'Kearsarge,' and declared that there was no such gun in Europe. They looked upon a 15-inch gut throwing a shot of 480 pounds as a monster. Now they have guns weighing 80 tons and capable of throwing a ton shot through 22 inches of solid iron armor.

"It seems as certain as mathematics, that, in the event of any early war on the part of the United States with a European power, the result of the contest would be wholly irrespective of either the courage we might be willing to display or the sacrifices we might be prepared to make. The key to the whole contest would be found to consist in the single problem of which side has the steel and iron ships and the heavy guns."

A Plea for a New Industry.

The Women's Silk Culture Association, whose zealous and well-directed efforts to domesticate the culture of silk in this country we have on more than one occasion taken the opportunity to praise, has lately made a demonstration which will go far towards convincing the numerous folk who have been persistently skeptical as to the practicability of the aims and purposes of the society.

The society had on exhibition in Philadelphia, some weeks ago, and after that in Washington, a specimen piece of brocaded satin which was woven at Paterson, N. J., of silk, grown and reeled in this country, and which was pronounced by all who saw it, and were competent to judge of its character, to be unsurpassable in quality. This specimen of dress goods was made from fifty pounds of cocoons, making fourteen pounds of reeled silk. The cocoons were contributed by fourteen different States, thus showing the extensive adaptability of our climate for the successful culture of silk.

This evidence on the part of the disinterested and patriotic ladies comprising the association of what it is possible to accomplish, does them infinite credit. They are thoroughly convinced of the entire practicability of the object for which they are striving, and by the unremitting zeal and energy they have displayed, they have succeeded in awakening an interest in the culture of silk far and wide throughout the country, and by their systematic and business-like methods they have succeeded in locating the experimental culture of silk in hundreds of places throughout the country. They have, besides this, shown that, when properly undertaken, the culture of silk can be made a profitable home industry, requiring no additional capital, and giving pleasant occupation to the women and children of the family, whose spare hours could be devoted to the work without entailing additional expense upon the head of the family, while the price at which the silk could be sold would prove a welcome addition to the family income.

The importance of the task which the association has set itself to accomplish, cannot well be overestimated; and the outlook for its ultimate success, in view of what it has succeeded in accomplishing in the brief period of two years since its organization, is most encouraging. When the statistics of our manufactures are considered, and the condition of the industry compared with that of the other textile industries, these statements will be appreciated at their proper value.

Mr. Lorin Blodget, the eminent statistician, and editor of the *Textile Record*, and one who is greatly interested in the work of the association, lately made such a comparison in a public address which is most instructive. He stated therein that we consume in the United States every year about $85,000,000 worth of silk goods, importing about $35,000,000, and producing at home about $50,000,000 worth. The silk industry has advanced with rapid strides. Ten or fifteen years ago it was of only small proportions. Now it is the third great industry of the textile class, cotton manufactures amounting to a value of $250,000,000 annually, woolen and woolen mixed to $300,000,000, and silk goods, as we have said, to about $50,000,000. We raise the raw cotton and produce the wool chiefly, but all except a very insignificant part of the raw silk is imported. We send abroad annually for nearly 3,000,000 pounds of reeled silk and 1,000,000 pounds of spun and waste silk.

Before the Revolutionary war, silk was raised in this country to a considerable extent for that period; and the industry was kept alive afterward. In 1844 the amount produced was large, but the loss and disappointment which followed the great mulberry excitement of forty years ago, when hundreds of people went into the raising of mulberry trees for the feeding of the silk worms, gave a blow to the business from which it has never recovered. At that time there was a wild speculation in the mulberry trees, and visions of fortune rose before those engaged in it. The expected demand, however, did not come, and instead of gain there was widespread loss.

About the time the association made the announcement of its intention to produce the specimen of dress goods above referred to, one of the Paterson papers published an article declaring American raised silk to be inferior in quality, and unfit for the best fabrics. This untruthful declaration was promptly challenged and publicly refuted by Mr. Blodget in the address here referred to, and the association made a public exhibition of their superb specimen to invite criticism and comparison. Mr. Blodget illustrated his address by the exhibition of specimens of silk raised and reeled here in comparison with samples of the best Italian varieties, and with foreign silk in a number of manufactures. He found, by the aid of the microscope, that in many descriptions of silk goods sold in this country—chiefly those imported—silk of a very inferior fiber had been introduced. Of the samples he exhibited, taken from European and American sources, he declared that those reeled at Philadelphia were the best. All the tests he could apply justified the assertion, so that he was ready to "guarantee that when the same number of fibers are reeled from the cocoon in the raw silk reeled here, taking an average of the specimens, the fabric ultimately produced will weigh heavier in dress goods, or in handkerchiefs, than if made of the same number of cocoon fibers sent here as Italian."

In a former editorial reference to this subject, we described the improved reel which the enterprising association succeeded in having constructed for the use of those desiring to engage in the reeling of silk; and we may add hereto the statement that during the present year, the association has established a school in which a number of pupils are being instructed in the art. All this is eminently practical, and we have the utmost confidence that so much well directed zeal and energy must result in success.

On the question of the possibility of competition of our people with the cheap labor of Europe, Japan and China, Mr. Blodget states the case in the following sensible fashion: He contends that silk can be economically raised at home, because a farmer can add its culture to his other work without any considerable investment of capital, and without employing outside labor. When the trees are grown, the work can be done by any one member of the family, or by as many more as may choose to engage in it. It can employ the spare time of women or children in the house, and the price at which silk is salable would make the labor profitable, and bring in a welcome addition to the resources of the family.

If we could raise in this country all the raw silk needed in our manufactures, thus placing the industry on the footing of the cotton industry, the addition to the wealth of the country would be considerable.

Basic Scorlæ of the Bessemer retorts, Martin furnaces, etc., containing as they do from 10 to 15 per cent of phosphoric acid, M. Naujean thinks could be utilized with advantage in the manufacture of artificial manures.

An Improved Leveling Instrument.

We show and describe herewith a much simplified and practical leveling instrument, designed and manufactured by Mr. Wm. T. Comstock, of No. 6 Astor Place, New York, and which has met with much approval from those competent to judge of the merits of such instruments, by reason of its combination of simplicity, accuracy when properly used, and cheapness, the last qualification being quite an important one. The object of the maker appears to have been, in designing the instrument, to supply the wants of many persons, such as architects, masons, builders, farmers and others, to whom the handling and adjustment of the more elaborate and complicated instruments in vogue would be difficult or impossible, and to provide one in their place, so much simplified, and at the same time accurate, that with ordinary care and intelligence the tyro will be able to use it satisfactorily. A glance at the accompanying engraving will suffice to make it clear to any one familiar with the appearance of instruments of a similar kind, that this one has been reduced in its construction to the fewest parts consistent with accuracy in use, and the parts are disposed in very compact form, insuring lightness and convenience.

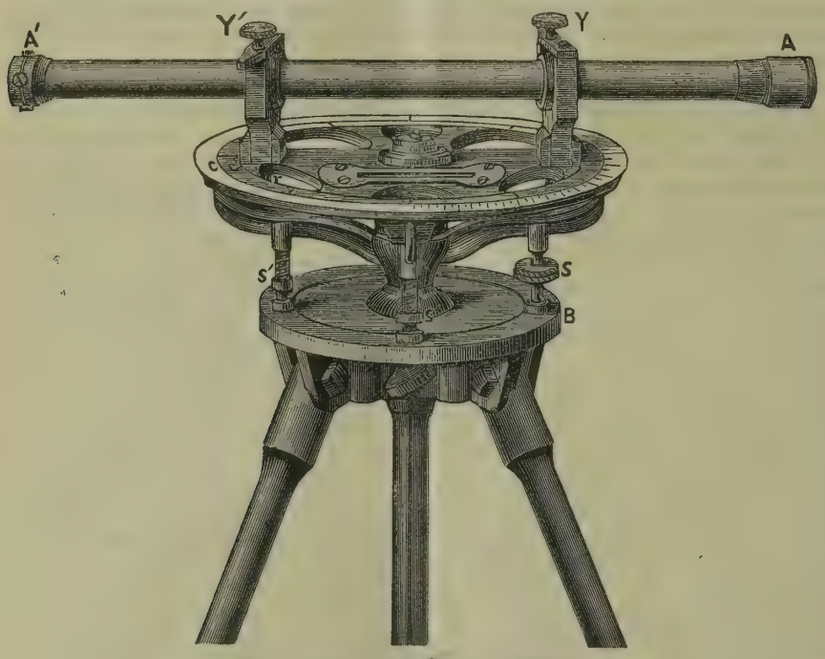


Fig. 1.—THE COMSTOCK LEVEL.

The instrument, briefly described, is made of brass, lacquered so that it will not corrode, and consists of the following parts: The sighting tube A A′ is 14 inches long, which rests in the Y's Y Y′, which in turn stand upon the inner circle C′. The tube at the Y's are two flanged rings, and it is held in place by latches fastened by thumb-screws. By loosening these latches, the sighting tube may be revolved to test the adjustment of the cross wires. Beneath the inner circle are screws *r*, by turning which with a key provided for the purpose, the end of the tube may be raised or lowered, and the line of sight adjusted to the line of level of the circles. The horizontal circles C C′ are concentric and revolve one inside the other, the outer one being graduated to degrees and the inner one marked to every 45°, so that the instrument may be used for laying off angles, squaring foundations, etc. The inner circle carries the bubble glass, set flush with the face of the plate. The outer circle forms a support and guide for the inner one, and to its spokes the two thumb-screws and springs are attached by which the instrument is brought to level. The base B is a solid disk, on the smoothly turned outer rim of which the little cups holding the feet of the screws and springs slip easily whenever the outer circle must be revolved. The center screw and shank of the ball are hollow, to permit of the passage of the cord holding the plumb-bob.

From the above condensed description of this instrument, it will be seen that it is capable of performing the functions of a plain transit as well as a level.

The instrument is put up in a handsome box with handles for carrying, and furnished with a surveyor's tripod and a short or mason's tripod. Its cost is only one-fifth to one-sixth that of the more elaborate instruments.

The leveling rod of the same maker is likewise a very simple and useful device, consisting of a round rod in two sections that can be screwed together, making it convenient to carry, and at the same time as firm as though of one piece, and has a target, as shown in the illustration (Fig. 2), made to slide on the rod. It is provided with two scales, that on one side being engineers' feet (decimal scale) and that on the other an architect's scale—feet, inches and eights, which add materially to its convenience.

Further information respecting these engineering instruments may be had on application to the maker, whose address is given above.

Purifying Lubricating Oils.—A German chemist, M. Kœllner, makes use of the following process for purifying lubricating oils, and so render them fit to be used again: He first puts the liquids into the lower part of a reservoir, closed at the top by a perforated lid; the residue is deposited at the bottom. By raising the reservoir at one end the oil passes into a second reservoir, then into two boxes joined together, filled with very clean cotton waste, and separated by a vertical perforated plate. The air circulates freely in the different apparatus, and the oil is then in a condition to be used immediately.

Cotton Seed Oil.

Expressing oil from cotton seed is a business, which, though new, is rapidly increasing in magnitude, and giving increased value to the staple crop of the South. A few years ago cotton seed was supposed to be worthless, except for enriching the soil, and of little value even for that. But the growing demand for oil in the arts and in households, led to a series of careful experiments with cotton seed, which showed that the oil in it could be expressed with great advantage, and now the manufacture of this oil is a steady and profitable business in the South.

In 1868 there were sixteen mills for manufacturing cotton seed oil in the United States, and in 1881 there were seventy. In 1868 cotton seed was worth $6 a ton; Now it is worth $10 to $12. A ton of seed will yield 35 gallons of oil, worth 40 to 55 cents a gallon; 750 pounds of oil cake, worth, at $35 a ton, $13; and $4 worth of hulls—so that the manufacturing process which the raw seed goes through nearly trebles the value.

It will surprise many to learn that this oil is rapidly superseding other vegetable and animal oils of a supposed higher character. It is used for lubricating machinery, grinding white lead and mixing paint, dressing salad, and in place of butter in cooking. It has to such an extent superseded olive oil that the Italian government has felt called upon to take extraordinary measures against its importation into that country. Italian vessels take cargoes of it at New Orleans, carry it to Italy, and bring it back under the name of olive oil, with the usual Italian labels on the bottles, thus enabling our home grocers to assert that it is imported. When refined, it is almost clear and without disagreeable taste; and whether it be as palatable and wholesome as olive oil or not, there is little doubt that it will in a few years take its place, on account of its cheapness.

It might be supposed by these uninformed that the supply of seed from which this oil is made is unlimited; but this is a mistake. There is little manufacture of it in the Southeastern States, the planters of that section preferring to return the seed to their thin lands. The cotton lands of the lower Mississippi do not require such careful fertilizing, and it is that region alone that yields the supply of seed for the oil mills located at Memphis, Helena, Greenville, Vicksburg and New Orleans. The business is confined to the South, and always must be, since the seed is too bulky to afford transportation to the North.

Fig. 2.

Overloading Safety Valves.

The practice, which prevails extensively, of loading the safety valves of steam boilers beyond the proper limit, is a most dangerous one, and cannot be too strongly condemned. Cases are very frequent where, by this means, old boilers, worn and thinned by corrosion, are regularly worked at a much higher pressure than they were originally intended for when new. There can be but one result of such a course, and that points unerringly toward disaster. The wear and tear of a boiler so overloaded and overworked is vastly increased, so that little if any economy results from the practice. It is true, that, in times of great business prosperity, when every department of a manufacturer's establishment is driven to its utmost capacity, the temptation to overwork a steam boiler is very strong; still the practice is, under any circumstances, wholly inexcusable. With most kinds of machinery, the only result of overwork is simply the failure of the machinery and the consequent pecuniary loss; but with steam boilers the case is different. Here the damage, in case of accident, is not confined to the boiler itself, or even destruction of adjacent property, but human lives are almost invariably sacrificed. We think every one will agree with us when we say under no circumstances is the imperilment of people's lives justifiable. Everything should be done that human knowledge renders possible to make the use of steam perfectly safe.

Tendency of Flour Dust to Explode.—Prof. Tobin has shown the Kentucky State Millers' Association some experiments which demonstrate conclusively that flour and other fine organic dust, under certain conditions, may become almost as explosive as gunpowder. He also showed that dampness destroyed the explosive tendency, and recommended the use of the wet bulb thermometer constantly in mills, and on its indication of dryness, the injection of live steam into the atmosphere.

Blowers and Exhaust Fans.

The production of air blasts, powerful and otherwise, under control, and the reverse operation (exhaustion), are indispensable for many branches of industry. Furnace and forge men require the blast to enable them to obtain the heat necessary to melt or render tractable the metals they work. For many metallurgical operations the hot blast has become indispensable, and modified forms of this are employed in miscellaneous industries where hot air is needed for drying purposes. As examples of this, we may name the drying of textile goods, the drying and seasoning of timber, the evaporation of moisture from fruit in the process of making dried fruit, the drying of leather and skins, and many other useful purposes. On the other hand, there are quite as many operations and processes in the arts where an exhaustion of air is required. As, for example, where offensive odors must be removed; or dust from rag and cotton pickers, flax and rope machinery; or where impure air, steam, smoke, dust, etc., must be removed from buildings, saw mills, mines, etc.

For these purposes the simplest and most popular devices in use are the rotary blowers and exhaust fans, of which we describe several forms adapted to special uses, and which are among the products of the Exeter Machine Works, of Exeter, N. H.

Referring to the cuts, Fig. 1 is a representation of the Exeter improved pressure blower. This form of the apparatus is built for the special service of iron founders, and other situations where a steady, heavy pressure is required. The cases of this form of blower are made extra heavy, and the fan wheel, though lighter than other makes, is represented to be fully as strong, on account of peculiarities of construction. The best materials and the most careful attention to workmanship are devoted to the running parts of these machines. They are provided with a self-oiling box of special construction (the patent of the makers), which enables them to be run at high speed without heating.

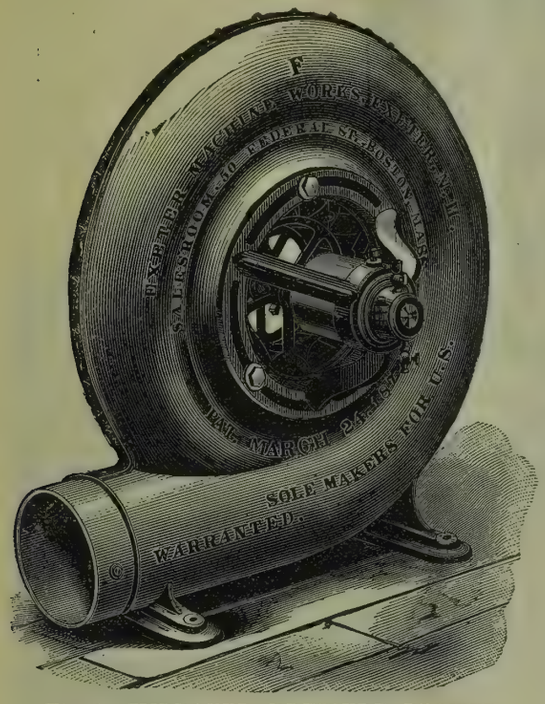


Fig. 1.—IMPROVED PRESSURE BLOWER.

Fig. 2 is a representation of the improved fan blower for rolling mills, forges, steam boilers, ventilation of mines, public buildings, and other places where a large volume of air is required.

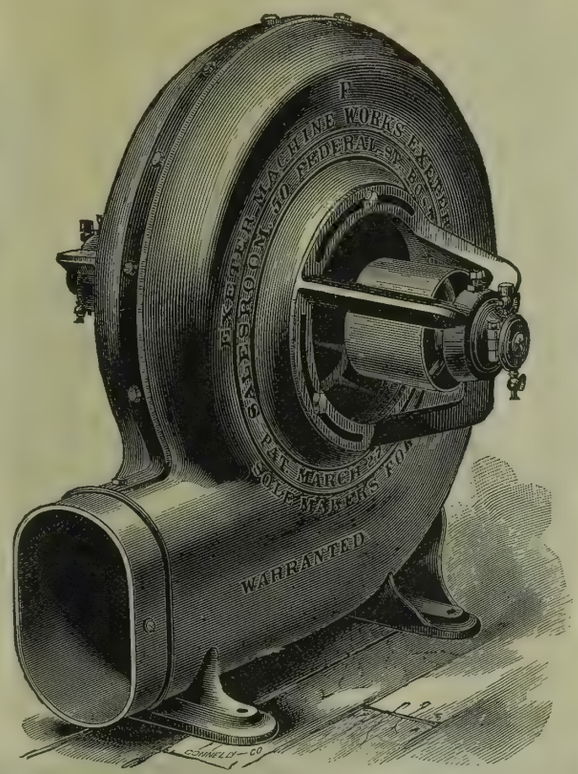


Fig. 2.—IMPROVED FAN BLOWER.

Fig. 3 is a representation of the improved exhaust fan of the same makers. The work for which this form of apparatus is specially adapted, is for removing shavings and sawdust from wood-working machinery; dust from sand and emery wheels; smoke and gas from manufacturing establishments generally; vapor, steam and offensive odors from paper mills, flax and rope machinery, dyeing establishments and try-kettles; the ventilation of public buildings, mines, underground apartments, etc. This form of apparatus has a free inlet. There are no boxes or shafts to interfere with the free circulation of air, dust or other material passing through it. The hanger supporting the pulley can be turned at any angle to take the belt from any direction. The exhaust fan, like the pressure blower and the fan blower, previously described, is furnished with the patent self-oiling box, to insure against heating, and they are constructed with inlet or suction pipe on either side, as may be most convenient, or are provided with an elbow inlet, adjustable to any angle.

In addition to these and numerous other forms and modifications of blowers and exhausters of various sizes, the makers likewise manufacture engines, pulleys, shafting, and all other machinery and appurtenances relating to this class of apparatus. Their machines have acquired a high reputation for excellence. These makers have built some of the largest machines in use for ventilating purposes. As examples of very large fans with engines attached, built by this establishment, we may name the ventilating machinery in use in the New York post office and hospital, and in the new capitol building at Albany. In the last named building two large machines are in use.

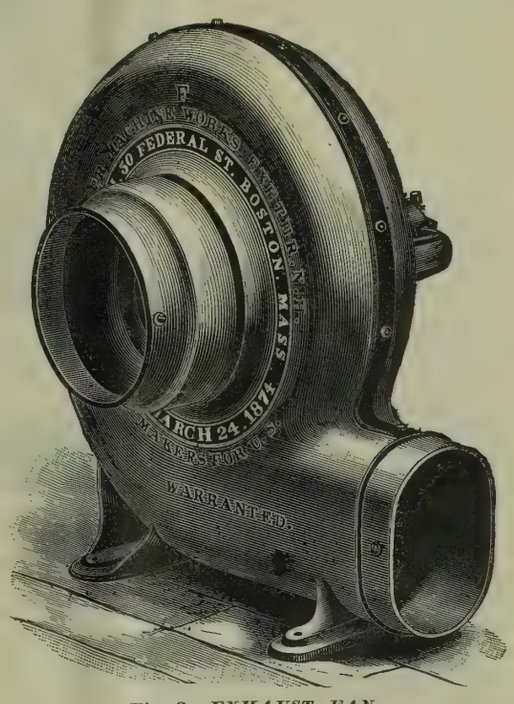


Fig. 3.—EXHAUST FAN.

ROTARY FILES.—A Connecticut mechanic has made a trial of rotary files for finishing planed surfaces. He is of the opinion that quicker and truer work can be done with these than with hand files, and that the surface is in better shape for truing with the shaper. His experiments have been confined to the planer, but he believes that his device may be properly and economically adapted to the lathe and milling machine.

The Hudson River Tunnel.

At the time of this writing (July 15th) about 1,200 feet of the north tunnel of the Hudson River tunnel have been completed from the New Jersey end. The nature of the river bed at this end of the work continues to be very favorable to the rapid progress of the work, it being a very tough silt, or fine river mud. The progress being made here will appear from the fact that 500 feet of this section have been built since February 1st. Two bulkheads, for the sake of precaution, have been introduced into this portion of the tunnel, one about 450 feet in advance of the caisson, and the other about the same distance in advance of the first. No work has lately been done on the south section of the tunnel; nor has any notable progress been made from the New York side. Here the soil to be penetrated is a mixture of sand, gravel and small boulders, most unfavorable for the prosecution of the work on any plan, and particularly dangerous in working on the Haskins system. The heading on this side has only been advanced 35 feet. Those in charge of the work seem to be aware of the necessity of using the utmost care to prevent the recurrence of an accident.

Life-Preservers in Factories.

The compulsory provision of life-preservers on steamers, and their manifest utility, suggest to a correspondent the propriety of a law compelling factory owners to provide at each window a cheap and efficient fire-escape, in addition to the appliances and stairways now required. One that would always be ready, easily understood, and usable by any person of ordinary intelligence, even under excitement, could be made in the following manner: To a staple firmly driven in the wall immediately over each window attach a rope or cord, say three-eighths of an inch in size, and long enough to reach nearly or quite to the ground. This cord should be well made and pliable, and might be knotted at intervals of about fifteen inches. The cord should then be rolled in a coil or ball, and tied in place by a small cord or strap, ready at a moment's notice to be untied and the end thrown out of the window. Men, and even women, could descend it with little difficulty, or the stronger and

cooler-headed could tie the rope about the bodies of the weaker and quickly lower them to the helpers below.

The Air Engine as Applied to Elevators.

The illustration given herewith shows the application of the air engine, manufactured by the Sherrill Roper Air Engine Co., as a hoisting power to passenger elevators.

The engine known very favorably for some time as the Sherrill Roper air engine, by reason of its safety, extreme simplicity of construction and its economy of operation, is excellently adapted for this species of service.

A few words respecting the principles of its construction and action will serve to make this clear. In this engine the air of the temperature of the surrounding atmosphere is drawn into the air pump; from this it is forced directly into the fire, which is contained in an air-tight furnace. Combustion and expansion ensue, and as the result of the expansion of the air and of the combustion products, a considerable pressure is developed in the fire-chamber. The charge of gases is then admitted into the cylinder, in which it is utilized precisely as steam would be, and is exhausted through valves in the same manner.

From the above explanation, the engine, as may be imagined, is simple, and in its design the makers have made it also very compact. The heated air is conducted from the furnace through the shortest possible pipes, thus insuring the utilization of the gases of the furnace to the greatest possible extent, and reducing the loss of pressure by cooling to a minimum. To insure durability, the furnace is lined with heavy fire brick, and the air being brought into contact with the fire, there are no iron plates or other heating surfaces to be destroyed by burning out.

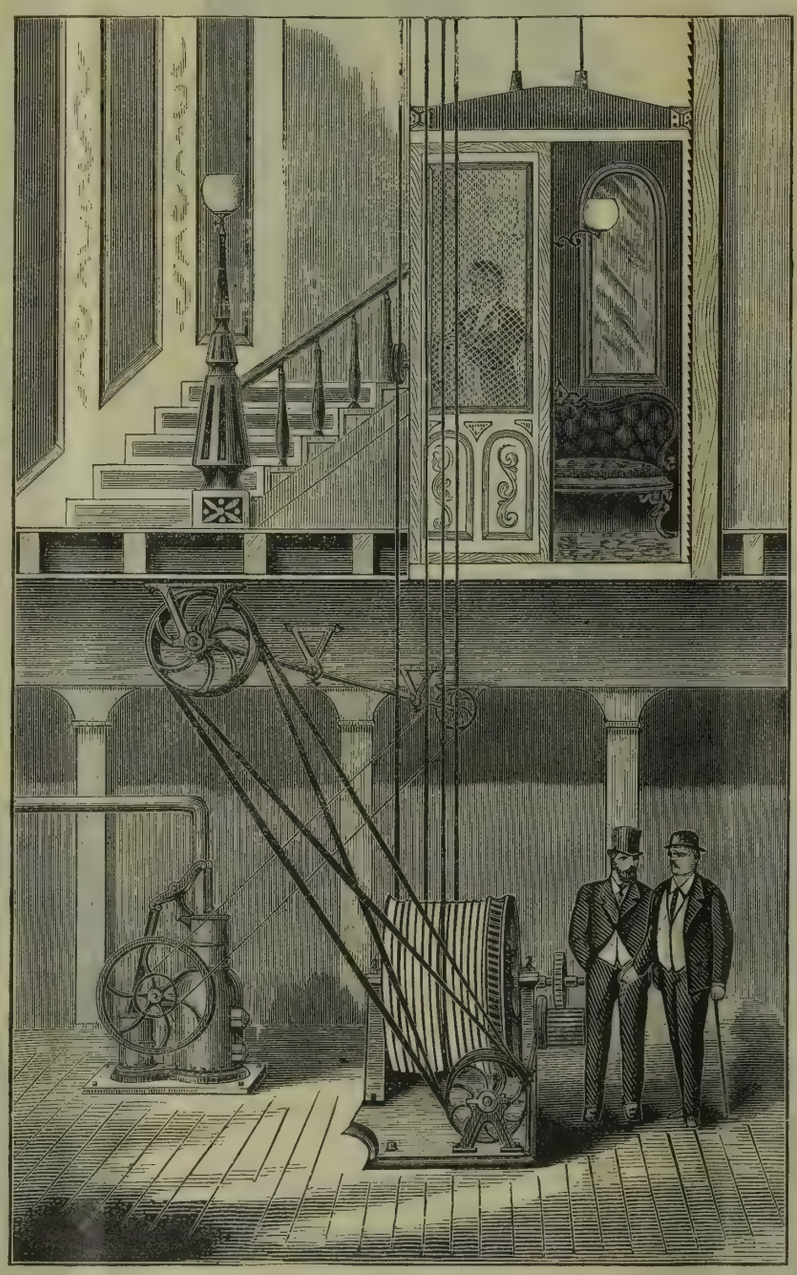
Again, the complete insulation of the cylinder by the partition and non-conducting material used, and its removal from external heated pipes, protect it from a higher temperature than that necessarily acquired by the expanded air supplied to it, thus securing the greatest economy in fuel, and avoiding subsequent loss of expansion and power, by cooling before it has performed its work. These are points of advantage of vital importance to the success of a hot-air engine where limited expansion can be obtained, which will be appreciated by all who may take the subject into consideration.

In all that relates to mechanical construction, the makers have left nothing undone, in respect to the use of the best materials and workmanship, to commend the engine to public favor. They have succeeded in producing an exceedingly simple, efficient and economical engine, compact and durable, that requires but trifling skill to operate, and that is free from the unavoidable objections incident in the use of steam, and free from the danger of explosion. Their adaptability for every form of service where moderate power is required will be apparent without further explanation.

The application of the Sherrill Roper air engine to hoisting machinery is one for which it is especially well adapted. The illustration shows very well the engine and its relation to the hoisting mechanism, without the necessity of describing the latter, which, in the absence of an engraving showing details, could not be done satisfactorily.

We may add that the makers have provided numerous appliances for insuring safety in the operation of their passenger elevators and other hoisting machinery. They claim for their engine in its special service the following meritorious features: "It uses no water, cannot explode, does not increase the rate of insurance, will do the hoisting of an ordinary store for less than fifty cents per day, and can be attended by any ordinary employé without seriously interfering with his other duties. It is in construction strong, simple and durable; and long and successful operation in driving elevators prove it to be unequaled in this field."

The Sherrill Roper Air Engine Co., of 91 and 93 Washington street, New York, are the manufacturers.



AIR ENGINE HOISTING PASSENGER ELEVATOR.

The Chronograph for Engineering Purposes.

At the Philadelphia meeting of the American Society of Mechanical Engineers, Mr. M. R. Eckart, very widely known on the Pacific coast as designer of some of the largest and finest mining and milling machinery of that section, described a chronograph for measuring and recording the velocity of pumping machinery. He has tried the Hipp escapement, and finds that with modifications, introduced to meet altered conditions, it works very well.

The instrument has been successfully applied to several of the different types of large pumping engines found on the Comstock lode, such as direct-acting, fly-wheel engines, geared pumping engines, and the Davy engines. It has also been used to determine the motion and relative motion of pump rods, and pumps some 2,500 feet below the surface engine driving the same, and at intermediate points. The results are exceedingly interesting and instructive, and as numerous indicator cards were taken from the engines and pumps simultaneously with the motion diagrams, nearly all conditions of motion and power, during the time under consideration, were definitely determined.

Some very important results of the elasticity of long pump rods are clearly set forth in one case: A rod at a point 1,800 feet below the surface showed a positive pause, while the engine driving it was nearly at its point of maximum motion, and pumps attached to the rods may have, and do have, strokes in excess of or deficient to the stroke of the engine driving the same, and to an important extent. Hence, it can be definitely stated that any consideration of the motion of pumps, or discharge capacity of the same, driven by a long line of pump rods based upon the motion or stroke of a surface engine alone, will in no way be even approximate, unless the elasticity and effects of counterbalancing by balance bobs on that elasticity are also considered.

The effects of different degrees of compression upon the engines and motion of the pump rods in passing the centers have been considered, and the diagrams clearly show the importance of considering it in connection with the strength of the rods and balance bobs.

Mr. Eckart's latest use of the instrument in conjunction with an engine test, has been to determine, if possible, the rate of condensation of steam per second in the steam cylinders of a pumping engine, where the change of motion due to each fractional part of the stroke was determined. Also a ten-hour experimental trial, to show the economy of compression, as compared with a ten-hour trial of the same engine on the succeeding day, where no compression was used (otherwise all conditions being similar), has been made, when changes of velocity of piston were determined by the chronograph.

While it is well known that a committee of the British Association applied a chronograph of Morin's type, in 1843–44, to the determination of the velocity of the piston for a Cornish pump engine, Mr. Eckart believes that there was no application of the instrument to the rods below ground, and that this is the first application of a chronograph of sensitive construction ever made to pit work and the other purposes so briefly mentioned.

ARTIFICIAL MOTHER-OF-PEARL.—A Swiss experimenter is reported to have manufactured artificial

mother-of-pearl which cannot be distinguished from the genuine.

Recent Improvements in Wood-Working Machinery.

Figs. 1 and 2 represent an improvement in saw swages, devised and patented by James L. Pitts, of Grand Rapids, Mich. Of the cuts, Fig. 1 is a perspective view and Fig. 2 a side view of the device, which is constructed so as to be readily adjusted to saw teeth of any size. H represents the swage, which terminates at one end in a handle to be grasped by the hand, and the other bends at right angles, as seen in Fig. 1, and is provided with a number of tapering grooves *a a a*, sloping downward in front towards the swage plate K. The latter tapers also, decreasing in size to correspond with the swage proper, and is made of tempered steel. It is keyed to the handle, and may readily be removed and replaced by a new one if desired. The bend X in the handle allows the swage to be held under a tooth and pressed downward, so that a saw tooth may fit into the bend, thus allowing the swage to be readily used at the largest point.

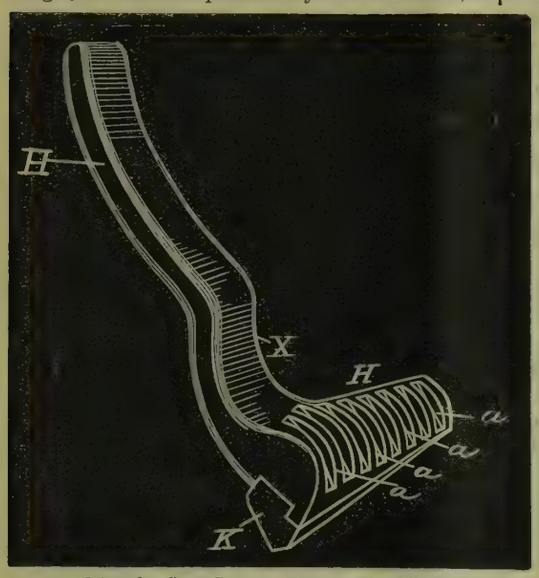


Fig. 1.—Saw Swage—Perspective View.

In using the device, the grooved portion is placed downward in cases where the saw teeth are up, so that one groove fits over one tooth, as shown on tooth T. Then, by lowering the handle, the point of tooth T′ is brought just over the edge of the swage plate K, as shown in Fig. 2. Then, with a small hammer, the point of the tooth is flattened or drawn out into the form required.

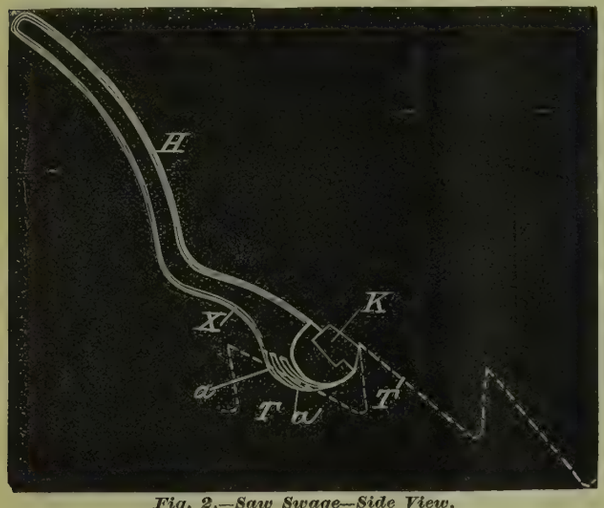


Fig. 2.—Saw Swage—Side View.

The swage and plate K, diminishing in size, allow the device to be applied to saw teeth of all sizes, which adjustability is still further increased by the sloping grooves *a a a*, as above described.

Eben M. Boynton, of lightning-saw fame, has lately patented the improvement in cross-cut saws shown in Fig. 3. The invention is a modification of the form of construction adopted in the saws of this well-known maker. In the cut, A represents a saw having M-shaped cutting teeth B, each provided with two points *a a*, dressed to cut in line, and two outer cutting edges *b b*, slightly inclined outward from the points. In connection with this feature, the invention embraces the combination therewith of the M-shaped clearing teeth C, with the points *c c*, and vertical edges as shown at *d d*. These clearing teeth are arranged alternately with two or more of the cutting teeth above described.

Fig. 4 represents a form of construction of a combined scroll and circular sawing machine, devised and patented by Abraham Showalter, of Palaskala, Ohio, the novelty of which resides in the construction of the frame and of the scroll saw hanging device. The inventor provides a vertically adjustable table *g*, the top-frame bracket of which has an elevated part *d* for carrying and supporting the circular saw shaft, the front part *f* being depressed for carrying and supporting the crank shaft for operating the scroll saw and the pulley M for operating the circular saw. A U-frame supports and carries the scroll saw.

Fig. 5 gives a view of an improved saw-mill dog, devised by D. Hedman and H. Wadham, of Evansville, Ind. The object of the inventors is to make as efficient a device as possible in simple and durable form.

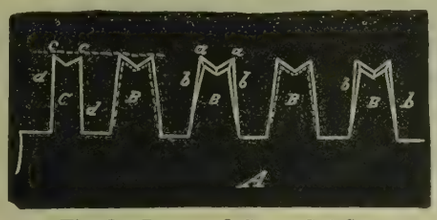


Fig. 3.—Improved Cross-Cut Saw.

The invention consists of a vertical standard A, T-shaped in cross section, which is provided with a vertical rack B. In connection therewith is the vertically adjustable carriage C, fitted on the standard head *a*. An operating lever D is pivoted in the carriage, and is provided with a mutilated gear pinion *e*, the teeth of which are adapted to engage or to pass by the rack, as desired. The carriage is slotted to admit the insertion of the dog G, which may be adjusted longitudinally with the aid of the pin I, which passes through holes *i* in the dog. In operating, the handle of the lever is thrown into the position shown in Fig. 5, and the dog is adjusted. The carriage is then allowed to drop until the point of the dog is in contact with the log. The lever is then thrown down so as to engage the teeth *e* with the rack, until the point of the dog is firmly driven into the log. By reversing the operation, the dog is raised and the log released.

Explosive Properties of Coal Dust.—Prof. Abel, in a paper on the dangerous explosive properties of dust in mines, etc., observed that the supposition that extensive coal mine explosions may be produced by coal dust alone, in the complete absence of gas, necessitates the fulfillment of conditions which cannot be at any rate very exceptional; but its acceptance is unnecessary to add to the formidable character of coal dust as an agent of destruction in mines. The possibility of dealing with the dangerous dust in mines should, therefore, be as much an object of earnest work as has been the improvement of ventilating arrangements in mines. The actual removal of dust accumulations being in most instances impracticable, the laying of dust by an efficient system of watering the mine-ways is a matter deserving serious attention. Although in some cases such a measure is not readily applicable without injury to the workings, it has already proved in some districts to be unobjectionable and susceptible of very beneficial application. The employment of deliquescent substances (calcium chloride, sea salt, etc.) in conjunction with watering, has also been advocated and tried to some extent with success.

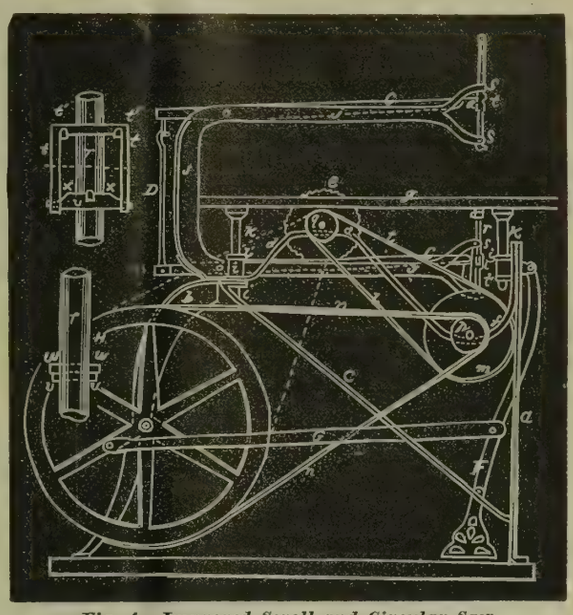


Fig. 4.—Improved Scroll and Circular Saw.

Making Theaters Safe.

The horrors of the late Vienna theater fire, and the official investigation that followed, promise to be of service in creating an official control of such buildings of such a character as will more effectually insure the safety of the public. The Minister of the Interior has sent out to all the governors of the provinces of the empire the draft of a bill which he has prepared for the purpose, and of which the following are the main provisions: In every town where there is a theater a local commission is to be appointed, composed of representatives of the municipal authorities, the police, the medical profession, the fire brigade, and impartial experts. These are to exercise a general supervision. Further, a similar local commission, but comprising members of the Diet, is to

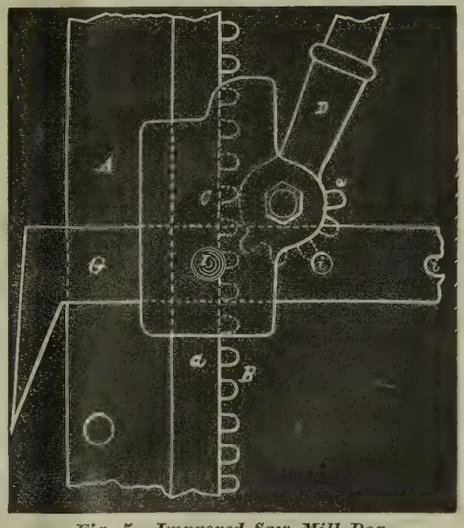


Fig. 5.—Improved Saw-Mill Dog.

be attached to the Stadtholder's office in each province. All new theaters are to be detached from other buildings, and are to contain no store or painting rooms. Every inflammable substance used in the performances is to be impregnated with fire-resisting fluids; and the most minute precautions are to be taken for insuring proper inspection. It will also be provided that there shall be an open gangway between every six rows of seats, that a shaft for the escape of smoke shall be erected, and that the number of the audience shall be strictly limited to the capacity of the theater.

Building Intelligence.

Architects, Builders and Contractors are invited to send us items of interest for this department. It is our object to notice only the more important operations in building, our space being too limited for the publication of minor matters, which, besides, possess only local import. We wish to publish only such intelligence as is of general interest.

New York City Building Items.

A chapel for All Saints' Church is to be erected on Madison avenue, between 129th and 130th streets, at a cost of $34,000.

B. T. Babbitt intends to erect at Nos. 47, 48 and 49 West street an eight-story fire-proof soap factory, at a cost of $45,000.

Work has been begun on the mammoth apartment house of Jose de Navarro, on Seventh avenue between Fifty-eighth and Fifty-ninth streets.

The Harlem Congregational Church is to erect a new place of worship at 121st street and Madison avenue. It is to be 73 feet front and 118 feet deep, and is to cost $45,000.

A seven-story building is to be erected at Forty-second street and Fourth avenue, by the Lincoln Safe Deposit Co., of which Thomas L. James is president. It is to cost $300,000.

The old Franklin Market building, at the foot of Old Slip, is to be torn down to make way for a new police station. The dimensions are about 29 feet 10 inches by 165 feet.

Christian Blinn proposes to erect three three-story flats, with stores, on the northwest corner of the Boulevard and Eightieth street, 25 by 54 feet by 102 feet 1 inch each.

John G. Prague is at work on the plans for two five-story apartment houses, 60 by 90 feet by 100 feet 5 inches, to be erected by Frances A. Croft, on the north side of Fifty-seventh street, 246 feet east of Second avenue.

D. & J. Jardine are engaged on the plans for a new church building to be erected by the Protestant Episcopal Church of the Incarnation, on the northeast corner of Madison avenue and Thirty-fifth street. It will cost about $32,000.

D. & J. Jardine have plans in hand for the erection of a four-story store building, to be used as a fish market, at Nos. 134 and 136 Beekman street, 25 by 39 feet. The owner is Mrs. John Steward. It will cost $16,000.

A. B. Ogden has plans in hand for the erection of three five-story flat houses on the south side of Fifty-fifth street, 146 feet west of Third avenue. They will be 25 feet 2¾ inches by 83 feet by 100 feet 5 inches. The owner is Mark Rinaldo.

F. A. Thurston will shortly commence the erection of three first-class four-story brown stone flat houses, on the plot of ground recently purchased by him, on One Hundred and Twenty-sixth street, between Sixth and Seventh avenues.

William Jose is engaged on the plans for four five-story flat houses, to be erected on the northwest corner of Tenth avenue and Sixty-first street, by I. Schaeffler, F. Herlein and G. Reichert. They will be 25 feet by 62 feet by 92 feet each.

Louis L. Todd intends to erect a ten-story apartment house and restaurant at Nos. 39 to 45 West Twenty-seventh street. The building will be of brown stone and brick, with fire-proof halls and stairways, and when completed will cost $180,000.

Robert McGinnis proposes to erect three four-story brown stone flat houses on the south side of One Hundred and Twenty-seventh street, 150 feet east of Seventh avenue. There will be two 20 feet front, and one 22 feet 6 inches front, the cost being estimated at $45,000. The architect is C. Baxter.

George W. da Cunha has prepared plans for the new Gramercy family hotel, at Gramercy Place and Twentieth street. It is to be nine stories high, the first and second stories of stone, and the others of brick, with stone and terra-cotta trimmings. It will cost $350,000.

C. Baxter is making drawings for six four-story flat houses, 22 feet 2 inches by 67 feet by 100 feet, to be erected on the south side of One Hundred and Twenty-ninth street, 125 feet east of Eighth avenue. The fronts will probably be of Ohio stone, and it is estimated that the cost will be about $100,000.

A new building for St. Vincent's Hospital is soon to be erected on the south side of Twelfth street, between Sixth and Seventh avenues. It will be of brick and stone, 133 feet wide by 48 feet deep, and four stories high. The plans are filed in the name of the Sisters of Charity. The building will cost about $150,000.

The plans for the large office building which is to be erected on the site of the old Washington Hotel in Battery Place, between Broadway and Greenwich street, have been filed. The structure will be eleven stories in hight, with a frontage of 181 feet, and an average depth of 100 feet. The walls are to be brick, and the front will be ornamented with copings of Belleville blue stone. The floor beams will be of iron. It is estimated the building will cost $900,000. A stock company, of which J. B. Lindley, of 121 Broadway, is president, will own the building.

R. G. Mitchell & Co. are to erect an extensive candle manufactory on the property just purchased by them on South street, between Gouverneur and Jackson streets, 70 by 140 feet. The same firm will erect a mammoth warehouse on the plot of ground purchased by them just one year ago for $35,000, on the north side of Monroe street, 95 feet 3 inches east of Scammel street, 96 feet 10 inches by 192 feet, running through to Madison street, 97 feet 11 inches by 192 feet. The architects for these extensive improvements are not yet selected, but it is the intention of Mitchell & Co. to commence work as soon as practicable.

Cowan Keyes proposes to commence the erection of a four-story flat house, 30 by 72 feet by 100 feet, on the north side of One Hundred and Thirty-second street, commencing 185 feet east of Sixth avenue. The plans have been prepared by Andrew T. Wilson.

William F. Burroughs has drawn the plans for, and will shortly commence, the erection of three five-story brick flat houses, 25 by 90 feet by 102 feet 2 inches each, on the south side of Seventy-seventh street, 250 feet west of First avenue. The plans for these houses are unusually well arranged, as they afford extra good ventilation and light. There will be accommodations for four families on each floor, except the first, which will have three apartments.

Wm. Van Antwerp is about to erect a mammoth apartment house of peculiar and attractive design on the southwest corner of Park avenue and Sixty-second street. It will be nine stories high, 100 feet 5 inches by 85 by 100 feet, and front on Park avenue. It will be called the Oriental, and will be in what may be called the Byzantine style of architecture. The front will be of pressed brick, with brown stone trimmings, richly carved, and over the portico doorway there will be two handsome balconies. On the lower floor there will be four stores, a gentlemen's and a ladies' furnishing establishments, periodical store and a druggist's. In the basement there will be an extensive restaurant. On the first floor there will be a gentlemen's and ladies' reception-room, a gentlemen's reading-room and a billiard-room, in addition to two suites of apartments containing ten rooms and a bath-room each. The other floors will each contain four suites of eight rooms and a bath-room. The house will be finished throughout in hard wood, and heated by steam. The fire escape will be on the inside of the building, and there will be 300 feet of hose on each floor in case of fire. The floors will be all double and deafened throughout, and there will be a steam drying-room in the upper story. It will cost $175,000.

Although the first half of the present year was a busy one among the various branches of the building trade, the work accomplished was not so great as during the corresponding period of last year. As will be shown by the accompanying table, there was a decrease in the number of one class of buildings erected, while in others there was an increase. Three reasons are given for the small decline—the higher price paid for real estate, both in the upper and lower sections of the city, the high price of all kinds of material, and the extra wages demanded, with the probability of strikes occurring after the commencement of the work. There is a large amount of building going on, however, many of the large buildings begun last year being still unfinished. In addition to the new structures, a large number of buildings are in process of alteration at great expense. The principal falling off in new buildings this year has been in the erection of first-class dwellings, there being a marked difference in point of number and cost. The number of tenements with stores has also greatly decreased, while second-class stores are more in demand. French and English flats have become popular this year, the estimated cost so far being close upon $8,500,000 as against $5,000,000 for the first six months in 1881. It is believed that as soon as the labor strikes are fully arranged, the number of plans filed with the Building Department will not fall far short of those sent in last year. There is still a great demand for apartment houses. Last year fully nine million dollars were spent on this class of property. The following is a detailed statement of the building work done up to June 30th of this year, together with the corresponding figures for 1881:

1882.

Class.	Number.	Estimated Cost.
First-class dwellings	217	$6,480,200
Second-class "	53	193,700
French and English flats	322	8,455,000
Hotels	3	80,000
Tenements and stores	106	2,026,800
Tenements	228	2,769,950
First-class stores	38	1,620,500
Second-class "	9	1,070,600
Third-class "	13	16,250
Offices	14	1,273,889
Factories	45	968,750
Schools and colleges	5	296,325
Churches	10	323,500
Public buildings	14	681,000
Stables	69	1,138,000
Workshops	28	127,760
Frame buildings	86	387,090
Totals	1,260	$27,909,305

January to June 30, 1881, number of buildings of all kinds, 1,321; estimated value, $29,504,900. Decrease in value this year, $1,595,605. The cost for new buildings for the year was $47,784,670.

Miscellaneous.

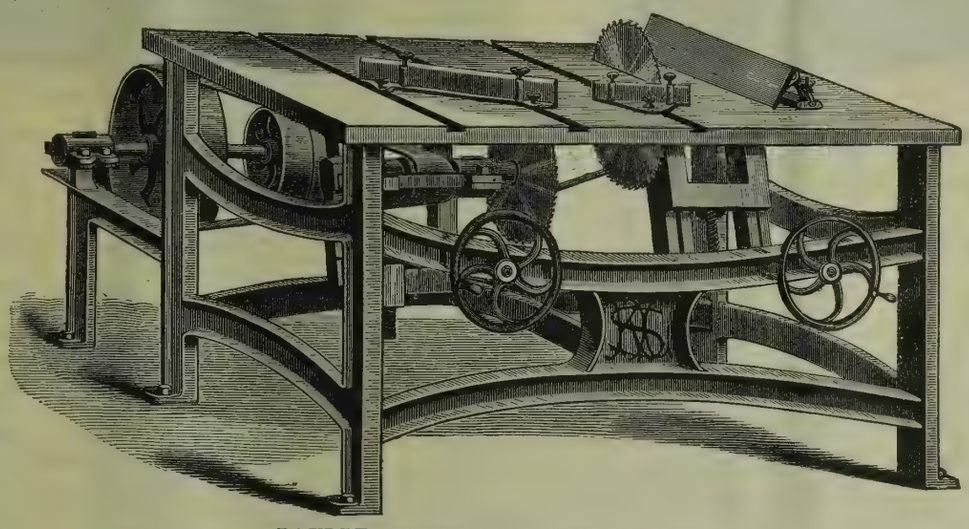
Work will be commenced immediately for the erection of a new Roman Catholic church, on the corner of Main and Mulberry streets, East Orange, N. J. The Rev. Father O'Connor will be the pastor, and it is expected that the cost of the improvement will exceed $5,000.

J. R. Thomas has the plans in hand for a memorial chapel to be erected by John H. Deane, in memory of his father and mother, on the campus of Rochester (N. Y.) University. It will be a stone structure, 75 by 115 feet, in the early English style of architecture, with a seating capacity of 500. On either side of the main entrance will be an ambulatory for memorial purposes.

Double Adjustable Saw Bench.

The accompanying engraving illustrates a double adjustable circular-saw bench, from the wood-working establishment of S. K. Lovewell & Co., of Chelsea, Mass., which embodies in design and construction so many features of convenience as to deserve the attention of all parties who are interested in wood-working machinery. The following description of this very practical labor-saving machine presents its salient points of merit:

To insure requisite strength and stability, it is constructed entirely of iron and steel. The top, which is very heavy, is 40×48 inches in dimensions, and is fastened to the frame at each corner, while the center is fastened in four places to the slide pieces, with the long end bolted to two arched braces in the center and to the side of the frame, thus giving the table unusual strength and stability. It is furnished with a splitting gauge, which can be tipped to any desired angle from square to miter; also two adjustable cut-off rests, one long double rest and one short rest. It is also furnished with a long gauge for cutting stuff to length. The arbors are of steel with a cone bushing in the collar. Size of hole in the saw, 1 inch. The machine has self-oiling boxes, which are raised and lowered by gears and a wheel in front of the machine. The boxes slide up and down in pieces planed out with gibs to fit, so that they can be tightened to take up any lost motion. The countershaft is fastened to the frame, which frame is fastened to the leg of the bench at one end; the other end is fastened to the floor. The shaft is adjustable on the frame. The driving pulleys are 18 inches in diameter and 4½-inch face. The tight and loose pulleys are 10 inches in diameter, 5½ inches face, and should make about 350 revolutions per minute. The loose pulley is self-oiling. The distance from arbors to counter shaft is 5 feet. Length of belt required, 11½ feet for each arbor, and 4 inches wide. Weight complete, about 1,150 pounds.



DOUBLE ADJUSTABLE SAW BENCH.

The makers of this very useful machine are manufacturers of an extensive line of wood-working tools well known to the users of this class of machinery throughout the country. Several of these machines, notably the "Eclipse" band saw and Gear's improved variety molding machine, have already been favorably commented upon in previous issues of this journal.

Emery Wheels.

The use of emery by the machinist and other workers in metal has, of late years, become very general. The employment of this substance was formerly confined to its application with oil, by means of cloth or emery paper, or to the polishing of a few articles by the use of a wooden wheel faced with emery. But wheels of solid emery, of all sizes, of different degrees of fineness, of varying degrees of hardness, and of shapes adapted to special requirements, are used today in every shop where pretensions to rapid and economical work are made.

The variety of the applications of emery is so great that we cannot pretend to include them all within the limits of an article adapted to our columns. It must suffice to say that this material has, in a very great measure, and with most economical results, taken the place of the file and of the hard labor of draw-filing and hand-polishing. Articles of iron or steel, just from the lathe or planer, are placed on the emery wheel, and in a small portion of the time hitherto required, are brought to the requisite polish and finish. Every shop has its sets of wheels, and usually a polishing room in which all work of this description is carried on.

There are a number of manufactories of solid emery wheels, each having its own name, and laying claim to particular excellencies for its products. Where there are so many of them that are meritorious, it is not surprising that one shop will prefer wheels of one make, while another will pin its faith to a different favorite. In most shops, however, the old-fashioned wooden wheel, with its leather face and emery dressing, is preferred for some descriptions of work; and for fine polishing, nothing is recognized as superior to a wheel made of the hide of the hippopotamus or the walrus; and even wheels of cotton cloth are used with cake emery.

The modern uses of emery, however, are not confined to the work of polishing or surfacing. The emery wheel is now applied to the same uses as a rotary cutter, which in reality it is, and a most efficient one; and to one whose knowledge of the applications of the material has been limited to an experience of twenty or thirty years ago in the machine shop, the range of the work that it now performs most effectively would be a revelation.

Of its many applications, we need only mention, in proof of this assertion, the gumming of saws (*i. e.*, cutting away the material between the teeth); dressing castings; trueing the surfaces of cylindrical bodies of hardened steel; finishing forgings; grinding lathe and planer tools, the heavy knives used by curriers in splitting sides of leather; grinding straight or spiral tooth rotary cutters, drills, fluted reamers, taps, dies, tools for cutting moldings, chisels, gouges, planer knives, paper-cutting knives, and the blades of scissors and fine pocket cutlery. In addition to these, the emery wheel, properly arranged on a frame adapted to the purpose, may be used in place of a planer in finishing from the forge gibs and keys, and other articles requiring to have a perfectly plane surface. The depth of the cut of the wheel's surface can, in such cases, be as accurately gauged and controlled as that of a steel cutter. A soft emery wheel, or one on which the emery is attached to an elastic surface like leather, is sometimes used to draw the temper of small hardened steel articles.

In home-made or dressed wheels of wood and leather, or of hide, the emery is attached to the surface by hot glue, or by a solution of gum shellac in alcohol; but in most of the solid wheels the entire wheel is made of emery, held in place by a substance that gives proper cohesion to the mass, the requisite solidity being assured by subjecting the wheel to immense pressure in the operation of manufacture, and by proper care in subsequent drying. The materials used to secure the proper cohesion of the particles of the emery, vary with different manufacturers, and in some cases their composition is held as a trade secret; but, generally speaking, the substances in common use for this purpose are principally glue, lac, caoutchouc, mineral cements, and similar substances, with modifying unessential ingredients. Of late, the peculiar composition of gum camphor and pyroxylin (soluble cotton), known as celluloid, has been advantageously employed for this purpose, some who have tested wheels made with it in comparison with those made of other compositions, claiming that the celluloid wheel outlasts all others and does not glaze so readily.

When an emery wheel glazes, it must be turned—an operation which at first sight appears to be impossible, when it is considered that the emery itself is so hard that it is used for the dressing of almost all the precious stones except the diamond. But the diamond, in one of its modifications, is the very material used for turning and trueing the emery wheel. The variety used for the purpose is the massive one known as "boart" or black diamond. One of these particles is fixed in the end of a bit of steel, as in a glazier's diamond, and is used against the wheel precisely as a chisel, gouge or hand tool in turning wood or metals. One variety of the solid emery wheel, however, known to the trade as Vulcanite, does not require the diamond tool, but is turned and trued either with a red hot iron or an ordinary turning tool, the surface of the wheel being warmed as it revolves, by means of a spirit lamp or gas jet.

Mineralogically, emery is an impure alumina, of the same nature as corundum, sapphire and the ruby (the latter being purer varieties), to which it is genealogically related. To its hardness, and the angularity of the crystalline fragments of which it is composed, we may ascribe its value as a cutting material for reducing metals; and this angularity persists even in the flour of emery, which is so fine as to form an impalpable powder, giving no sensation of grittiness when rubbed between the fingers.

Reclaiming the Zuyder Zee.

The Hollanders seem untiring in their efforts to reclaim lands from the dominion of the sea. Their latest efforts in this direction are being directed towards the annihilation of the Zuyder Zee, thus making available for agricultural purposes a large extent of country. This is an immense undertaking. This gulf of the sea was formerly a lake, but by an inundation in 1282, it was united to the German Ocean. To make sure work, or at least to reduce the probabilities of failure to the minimum, civil engineers have been busy for ten years past in perfecting plans and making estimates. It is reported that this preliminary work is now completed, and that the labor of building the walls will soon be commenced. A dyke about 24½ miles in length will be constructed of sand and faced with clay, reaching 16 feet above the level of the sea, which will make it about 6½ feet above the highest tide. The thickness of the dyke will be such as will enable it to resist the heaviest seas. Operations will begin at four different points, and the calculation is to have it completed in from seven to ten years, at a cost of $46,000,000. The experience of the past has given the Hollanders such skill in this peculiar work, that it is safe to infer that

they are not entering upon a chimerical scheme. When completed, the territory which will be added to Holland will afford her crowded and industrious population an opportunity to expand which has long been needed.

The Proportions of Riveted Joints.

[*Continued from page* 160, *July Number.*]

Continuing the analysis of the practice of different boiler makers in proportioning riveted joints, by the rule enunciated in our last issue, we have in Fig. 6, plate Nos. 3, 2 and 1. Rivet holes, $^{11}/_{16}$ inch diameter; pitch of rivets, $1\frac{7}{8}$ inches.

Strength of plates at joint $= \frac{1.875-.6875}{1.875} = 63$ per cent of solid plate. Strength of rivets at joint No. 3 plate $= \frac{.37122}{1.875\times.259} = 76$ per cent of solid plate. Strength of rivets at joint No. 2 plate $= \frac{.37122}{1.875\times.284} =$ 70 per cent of solid plate. Strength of rivets at joint No. 1 plate $= \frac{.37122}{1.875\times.3} = 66$ per cent of solid plate. Pitch too small, especially for Nos. 2 and 3. Same remarks apply as in the case of Fig. 3.

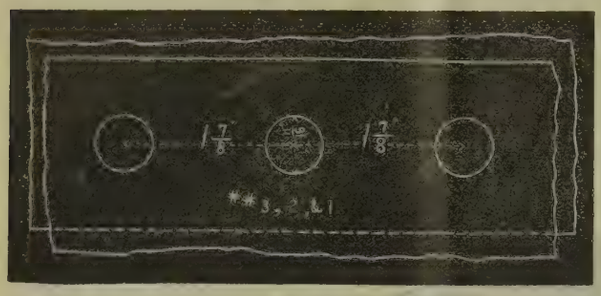


Fig. 6.

Fig. 7.—Plates Nos. 0, 00 and $\frac{3}{8}$ inch. Rivet holes, $\frac{3}{4}$ inch diameter; pitch of rivets, $1\frac{7}{8}$ inches. Strength of plates at joint $= \frac{1.875-.75}{1.875} = 60$ per cent of solid plate. Strength of rivets at joint in No. 0 plate $= \frac{.44179}{1.875\times.34} = 69$ per cent of solid plate. Strength of rivets at joint No. 00 plate $= \frac{.44179}{1.875\times.358} = 66$ per cent of solid plate. Strength of rivets at joint in $\frac{3}{8}$-plate $= \frac{.44179}{1875\times.375} = 63$ per cent of solid plate.

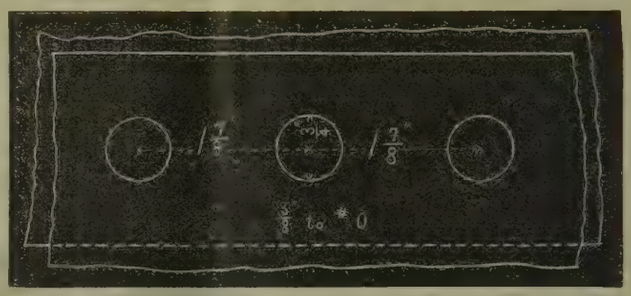


Fig. 7.

Fig. 8.

Fig. 8.—Plate $\frac{3}{8}$ inch thick; rivet holes, $^{13}/_{16}$ inch diameter; pitch of rivets, $2\frac{1}{4}$ inches. Strength of plate at joint $= \frac{2.25-.8125}{2.25} = 64$ per cent of solid plate. Strength of rivets at joint $= \frac{.51849}{2.25\times.375} = 62$ per cent of solid plate. A first-rate proportion for $\frac{3}{8}$-inch plate.

Fig. 9.—Plates, $^{7}/_{16}$ inch and $\frac{1}{2}$ inch thick; rivet holes, $^{13}/_{16}$ inch diameter; pitch of rivets, 2 inches. Strength of plate at joint $= \frac{2-.8125}{2} = 59$ per cent of solid plate. Strength of rivets at joint in $^{7}/_{16}$ inch plate $= \frac{.51849}{2\times.4375} = 59$ per cent of solid plate. Strength of rivets at joint in $\frac{1}{2}$ inch plate $= \frac{.51849}{2\times.50} = 52$ per cent of solid plate. Rivet too weak for $\frac{1}{2}$ inch plate. It would be better to use larger rivets and greater pitches in both cases. See Fig. 3.

[*To be Continued.*]

The American Institute of Mining Engineers.

We learn from a circular received from the secretary of this institute, that it will hold its mid-summer meeting this year in Colorado. The institute will be in session, including the time spent in excursions, from Saturday, August 19, to Tuesday, August 29. The programme embraces a reception by the citizens of Denver, and a brief preliminary evening meeting on Saturday, the 19th; Monday, the 21st, will be taken up by a visit to Black Hawk and Central, with an evening meeting at Central City; Tuesday will be spent at Georgetown and Idaho Springs; Wednesday will be spent in Leadville, where an evening session will be held; Thursday and Friday will be devoted to excursions to the Leadville mines and smelting works; Saturday will be taken up by an inspection of the Pueblo Iron and Steel Works, and other metallurgical works; Sunday will be spent at Colorado Springs and Manitou; on Monday the party will return to Denver, where an evening reception will be held; and Tuesday will be taken up with the inspection of the Argo smelting works, Golden and its smelting works, and a final subscription dinner.

Special arrangements have been made by which members of the institute and their ladies will be favored with reduced rates of fare by the railroad companies. The attendance promises to be very large, the attractions, professional and otherwise, of the localities to be visited being of unusual interest. These will be enhanced by the fact that an exhibition of mining appliances, minerals, etc., will be in progress at the time of the meeting, at Denver, and by the unusual facilities for examining mines and works, and acquiring information concerning them, which will be afforded to the visitors.

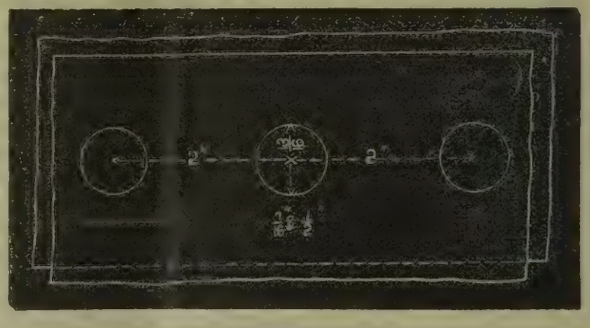


Fig. 9.

The Submarine Tunnel Between Italy and Sicily.

From the project presented to the Italian Ministry, and proposed to the Venetian Society of Construction, by Signor Gabelli, the following particulars are taken: The length of the submarine tunnel between Italy and Sicily will be 13,200 meters. The maximum depth of the sea above the line of tunnel is 110 meters. The thickness of rock between the roof of the tunnel and the bottom of the sea is 35 meters. The direction of the tunnel from St. Agata to Punta del Pizzo is almost due northwest to southeast. The two inclines descending to the tunnel will first run parallel with the shore and then descend to the lowest level by spiral tunnels. The length of these inclines is each 4,500 meters, and the area occupied by each spiral tunnel 350 meters. The degree of inclination will be 35 per 1,000—about that of the tunnel between Busalla and Pontedecimo, which has been found by experience to be perfectly practical. The center of the submarine tunnel will be on a higher level than the two ends. Wells and subsidiary tunnels will be constructed to drain off the percolating water, and the most difficult part of the line will be first commenced, which will at once show the geological construction of the ground, and the difficulties to be overcome. According to the opinions of all geologists, the bottom of the Straits of Messina consists of crystalline rock (granite, gneiss and mica schists). Neither in Calabria nor in Sicily can the upper strata that cover this crystalline rock be so thick as to reach the level of the bottom of the descending incline.

Preservation of Vulcanized Caoutchouc.

In a late communication to the German Chemical Society of Berlin, Herr E. Hempel, referring to the tendency of articles of vulcanized caoutchouc to become hard and to lose their elasticity, explains it to be due chiefly to the evaporation of the solvent employed during its manipulation and manufacture. It may be avoided, he asserts, by preventing this evaporation, or by substituting in place of the evaporated solvent, another. Laying the material directly in a bath of the solvent, he states, is disadvantageous, because too much of the solvent is taken up. On the other hand, the object will be satisfactorily attained by bringing the materials in an atmosphere saturated with the vapors of the solvent. Rubber stoppers, tubing, etc., that are still in good condition, may be indefinitely preserved against becoming brittle by keeping them, when not in use, in a chamber in which an open vessel containing ordinary petroleum is placed.

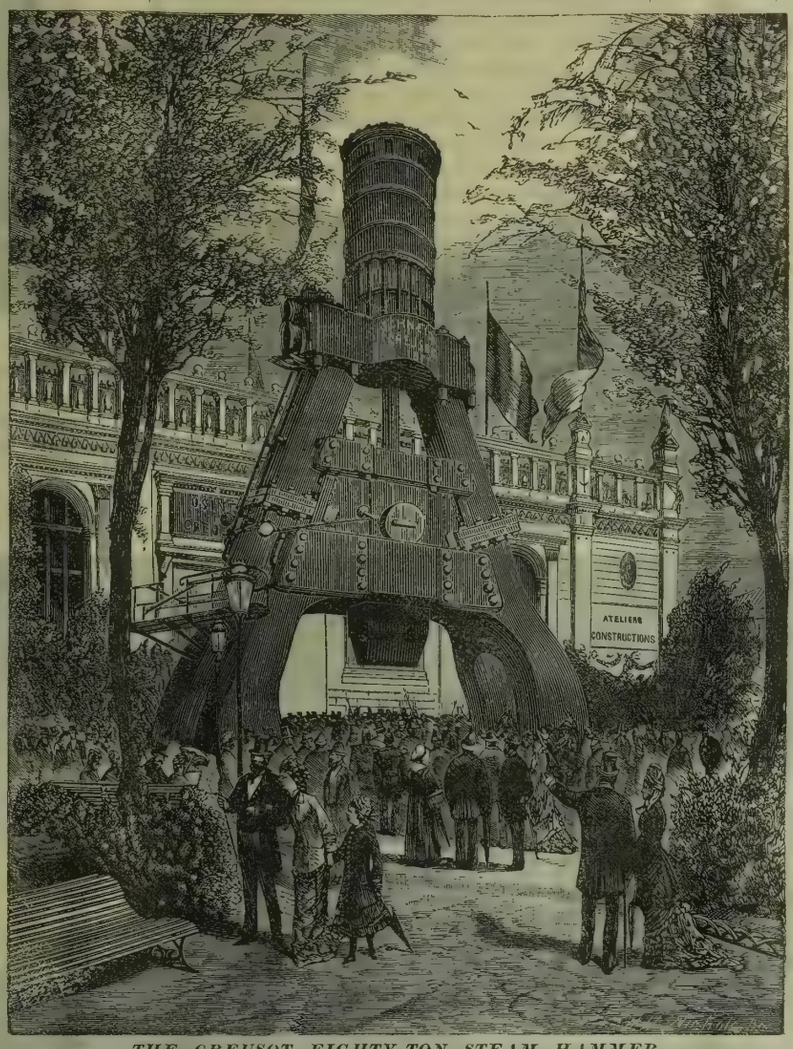
Old rubber objects that have become hard and brittle, will be quickly made soft and elastic by subjecting them for a short time to an atmosphere charged with the vapors of bisulphide of carbon. When they have been thus restored, they should be kept in a petroleum charged atmosphere. Where the alteration has proceeded so far as to have caused cracks in the stoppers, tubing, etc., this procedure will not answer, as the cracks cannot be closed by the action of the vapor.

The Progress of the Mechanic Arts.

In our last issue we gave an outline of the ground covered by the supplement to "Knight's Mechanical Dictionary," now in course of publication by Messrs. Houghton, Mifflin & Co., of Boston. The illustration published in connection with our remarks in that issue, though a highly attractive one, scarcely represented fairly the character of the work as a *résumé* of the progress of the mechanic arts during the period that has elapsed since the publication of the dictionary.

We give with this another of the admirable illustrations with which the supplement is profusely supplied, and which is more in keeping with the mechanical character of the work. The illustration is one of the Paris exhibition series, and represents perhaps the most remarkable of the special exhibits of that great exhibition, and one of the most notable specimens of mechanical handiwork—namely, the special pavilion of the Creusot Iron Works and the great 80-ton steam hammer, which all visitors to Paris at the time of the exhibition will recall as one of the prominent features. From the references made at the time to the exhibit of the Creusot works, which are to France what Krupp's great establishment is to Germany, we glean the following facts in relation thereto:

The Creusot Iron Works made a very extensive exhibit of their machinery and products in a pavilion erected specially for the purpose, which is seen in the background of the picture. The most imposing feature was the model of the great steam hammer, conspicuously placed in front of the building, and which, as one of the largest instruments of the kind ever built, attracted much attention. Other noteworthy features of the Creusot exhibit which were displayed in the interior of their pavilion, were a huge block of steel weighing 250,000 pounds, immense armor plates for armored ships, a marine engine of 2,000 horse-power, a fine locomotive, a plan in relief of the famous Creusot works, together with the particulars of the schools for over 2,000 children, and of the artisans' dwellings; besides many other interesting objects, of which we may name a statue to Eugene Schneider, the great engineer to whom the organization of these great works is due.



THE CREUSOT EIGHTY-TON STEAM HAMMER.

The illustration gives a faithful picture of the Creusot exhibit, from which a fair idea can be formed of the immense size and appearance of this masterpiece of mechanical skill.

In our former reference to the supplement from which we take the above illustration, we omitted to mention an important and convenient feature of the work, for which we make amends by calling attention to it here—namely: The value of a work of reference depends largely upon its index. When one has a question to ask of an ordinary encyclopædia, it is frequently very difficult to determine under which title or heading to look. The author has invented a system of what he terms "specific indexes," by the use of which the inquirer is guided straight to the information he is in quest of, even though he be entirely ignorant of the name of a thing and have but the most vague and general notion of its use. This is accomplished by grouping under the general title of each science, art, trade or profession a list or "specific index" of every article in the book bearing any relation to the subject in question. The titles of these indexes are in turn grouped at the beginning of the book, so that by a glance one may determine which clue to follow.

From the present and former notices of this work, which promises to be completed during the current year, our readers will be able to obtain a fair idea of its scope and utility.

Burnishing.

By burnishing the roughness of an object is flattened down until the surface is smooth and polished like a looking-glass. Burnishing is an important operation for electro-deposits, which consists of a multitude of small crystals, with intervals between them, and with facets reflecting the light in every direction. The deposited metal is hardened, and forced into the pores of the underlying metal, and the durability is thus increased to such an extent, that, with the same amount of silver, a burnished article will last twice as long as one which has not been so treated. The instruments employed for burnishing are made of different materials, and must be of great hardness and a perfect polish. Such are hardened cast steel, agate, flint and blood-stone. For metallic electro-deposits steel and blood-stones are especially employed. There are several qualities of blood-stone; its grain should be close, hard, and without seams or veins; it should leave no white lines on the burnished parts, nor take off any metal, and its color should be of an intense black red. The steel must be fine and close grained, and perfectly polished. Should the polish of any burnishing tool alter by use, it is restored by friction upon a skin or leather attached to a wooden block, which is fixed to the bench. The leather is covered with polishing rouge in impalpable powder, or, preferably, with pure alumina, obtained by calcining ammonia alum in a forge fire. Venetian tripoli, rotten-stone, tin putty, emery, or many other hard substances finely powdered, may be employed. The burnishing tools are of various shapes, such as a lance, a tooth, a knife, a half sphere, or a dog's tongue, and a considerable stock is necessary. The burnishing is divided into two distinct operations; the first consists in roughing, and the second in finishing. The tools for the first have a sharp edge, while for the second operation they have a rounded surface. The tools for the hand or the lathe are fixed by copper ferrules into short, round wooden handles, so that the hand is not influenced by their weight. The tools for the arm or vise are fastened to wooden handles sufficiently long to rest their slender part upon the arm or shoulder; the stouter lower portion is grasped by the hand. The burnishing tools and the objects must be frequently wetted by certain solutions, some of which facilitate the sliding of the instrument, or with others which have a chemical action upon the shade of the burnished articles. Of the first are pure water, solutions of soap, decoctions of linseed, and infusions of the roots of marsh mallow or liquorice. The second includes wine lees, cream of tartar, vinegar, and alum in water. When burnishing gold applied upon electro-deposits of copper, as in gilding with a dead luster by that method, pure water is used, to avoid producing a disagreeable red shade. A solution of green soap is sometimes preferred by operators, although when old it imparts an unpleasant tinge, owing to the sulphides of the liquor. When the burnishing is completed, the surface is wiped longitudinally with a soft and old calico rag.

The polish obtained by burnishing is called black when it reflects the rays like a mirror; and should the presence of mercury or a bad deposit prevent the tool from producing a bright surface, the object is said to be greasy. Articles which have been previously polished, and which generally receive a very trifling deposit, are not burnished, but rubbed with chamois leather and the best polishing rouge. Too thick or too rapid electro-deposits cannot be burnished, but must be polished by rubbing with leather and a mixture of oil and powdered pumice stone, tripoli or tin putty. Coarse powders are used at the beginning, and impalpable ones at the end of the operation.

Polished silver deposits are more agreeable to the eye than burnished ones, but the hardening of the latter renders them more durable.

Deadening Sounds.—The following plan for deadening floors is reported to have been made the subject of a recent patent. It is exceedingly simple, and not materially unlike plans that have been before proposed in this journal. A 3 by 6 inch plank is directed to be inserted between each joist, 2 inches from the bottom of the joists, and projecting 4 inches beneath them. The ceiling boards are nailed to these intermediate planks, and the space between is filled with sawdust to within one inch of the joists. By this mode of construction, the sound is said to be so effectually deadened, that the most vigorous hammering above cannot be heard in the story beneath.

Radiant Matter.

[*Concluded from page 156, July Number.*]

Radiant Matter Produces Heat when its Motion is Arrested.—During these experiments another property of radiant matter has made itself evident, although attention has not yet been drawn to it. The glass gets very warm where the green phosphorescence

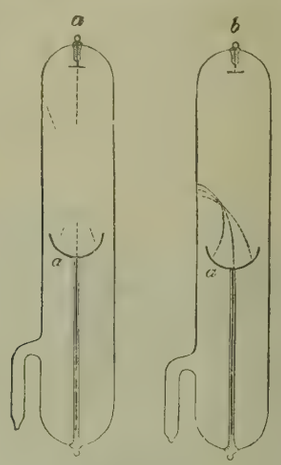


Fig. 19.

is strongest. The molecular focus on the tube, which was shown in Fig. 8 (page 133, June number), is intensely hot, and an apparatus has been prepared by which this heat at the focus can be rendered apparent. Fig. 19, *a*, is a small tube with a cup-shaped negative pole. The cup projects the rays to a focus in the middle of the tube. At the side of the tube is a small electro-magnet, which can be set in action by touching a key, and the focus is then drawn to the side of the glass tube, Fig. 19, *b*. To show the first action of the heat, the tube is coated with wax. The apparatus is put in front of the electric lantern (Fig. 20, *d*) and a magnified image of the tube thrown on the screen. The coil is now at work, and the focus of the molecular rays is projected along the tube. The magnetism is turned on and the focus drawn to the side of the glass. The first thing seen is a small circular patch melted in the coating of wax. The glass soon begins to disintegrate, and cracks are shooting starwise from the center of heat. The glass begins to soften, the atmospheric pressure forces it in, and then it melts; a hole *e* is perforated in the middle, the air rushes in, and the experiment is at an end.

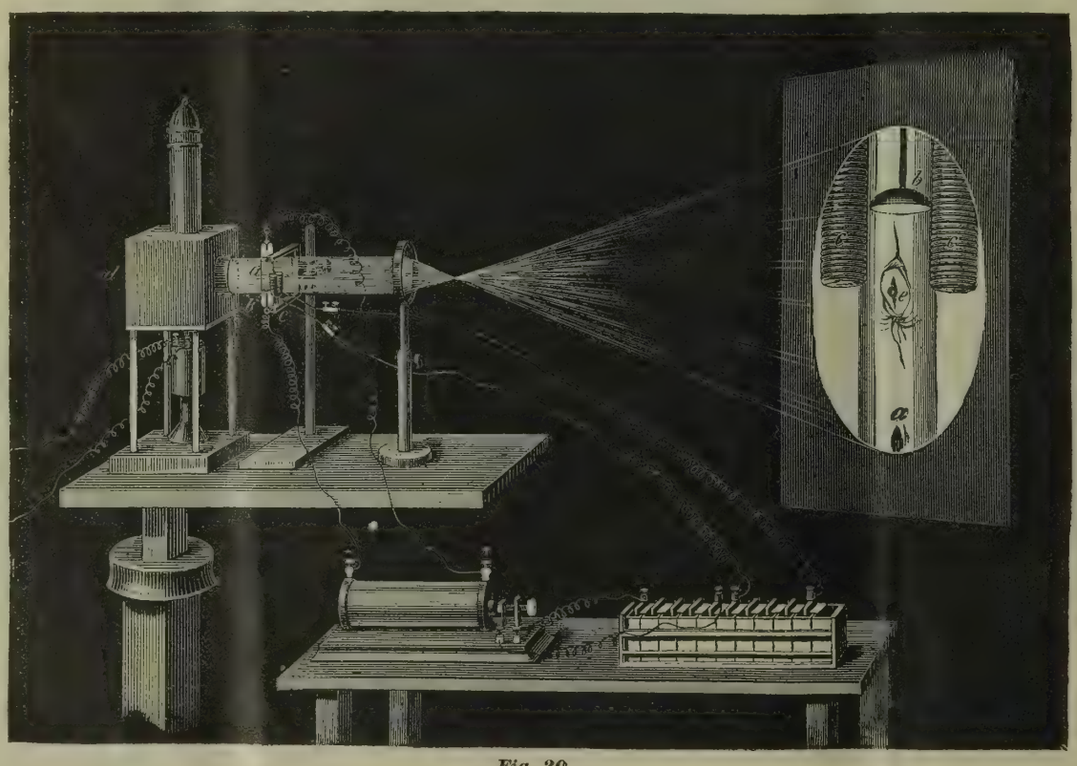


Fig. 20.

This focal heat can be rendered more evident if it is allowed to play on a piece of metal. The bulb, Fig. 21, is furnished with a negative pole in the form of a cup *a*; the rays will, therefore, be projected to a focus on a piece of iridio-platinum *b*, supported in the center of the bulb. The induction coil is first turned on slightly, so as not to bring out its full power. The focus now plays on the metal, raising it to a white heat. A small magnet is brought near, and the focus of heat can be deflected as was the luminous focus in the other tube. By shifting the magnet the focus can be driven up or down, or drawn completely away from the metal, leaving it nonluminous. The magnet is withdrawn, and the molecules let have full play again; the metal is now white hot. The intensity of the spark is increased, the iridio-platinum glows with almost insupportable brilliancy, and at last melts.

The Chemistry of Radiant Matter.—As might be expected, the chemical distinctions between one kind of radiant matter and another at these high exhaustions are difficult to recognize. The physical properties which have been elucidated seem to be common to all matter at this low density. Whether the gas originally under experiment be hydrogen, carbonic acid, or atmospheric air, the phenomena of phosphorescence, shadows, magnetic deflection, etc., are identical, only they commence at different pressures. Other facts, however, show that at this low density the molecules retain their chemical characteristics. Thus, by introducing into the tubes appropriate absorbents of residual gas, it can be seen that chemical attraction goes on long after the attenuation has reached the best stage for showing the phenomena now under illustration, and by this means we are able to carry the exhaustion to much higher degrees than can be obtained by mere pumping. Working with aqueous vapor, phosphoric anhydride can be used as an absorbent; with carbonic acid, potash; with hydrogen, palladium; and with oxygen, carbon, and then potash. The highest vacuum the experimenter (Dr. Crookes) succeeded in obtaining was the one-20,000,000th of an atmosphere, a degree which may be better understood if we say that it corresponds to about the hundredth of an inch in a barometric column three miles high.

It may be objected that it is hardly consistent to attach primary importance to the presence of matter, when extraordinary pains have been taken to remove as much matter as possible from these tubes, etc., and when we have succeeded so far as to leave only about one-millionth of an atmosphere in them. At its ordinary pressure the atmosphere is not very dense, and its recognition as a constituent of the world of matter is quite a modern notion. It would seem that when divided by a million, so little matter will necessarily be left that we may justifiably neglect the trifling residue and apply the term "vacuum" to space from which the air has been so nearly removed. To do so, however, would be a great error, attributable to our limited faculties being unable to grasp high numbers. It is generally taken for granted that when a number is divided by a million the quotient must

Fig. 21.

necessarily be small, whereas it may happen that the original number is so large that its division by a million seems to make little impression on it. According to the best authorities, a bulb of the size of 13.5 centimeters in diameter contains more than 1,000,000,000,000,000,000,000,000 (a quadrillion) molecules. Now, when exhausted to a millionth of an atmosphere, we shall still have a trillion molecules left in the bulb—a number quite sufficient to justify us in speaking of the residue as "matter."

To suggest some idea of this vast number, we take the exhausted bulb and perforate it by a spark from the induction coil. The spark produces a hole of microscopical fineness, yet sufficient to allow molecules to penetrate and destroy the vacuum. The inrush of air impinges against the vanes and sets them rotating after the manner of a windmill. Let us suppose the molecules to be of such a size that at every second of time a hundred million could enter. How long, think you, would it take for this small vessel to get full of air? An hour? A day? A year? A century? Nay, almost an eternity!—a time so enormous that imagination itself cannot grasp the reality. Supposing this exhausted glass bulb, indued with indestructibility, had been pierced at the birth of the solar system; supposing it to have been present when the earth was without form and void; supposing it to have borne witness to all the stupendous changes evolved during the full cycles of geologic time, to have seen the first living creature appear, and the last

man disappear; supposing it to survive until the fulfillment of the mathematicians' prediction that the sun, the source of energy, four million centuries from its formation will ultimately become a burnt-out cinder;* supposing all this—at the rate of filling just described, one hundred million molecules a second—this little bulb even then would scarcely have admitted its full quadrillion of molecules.†

But all these molecules—this quadrillion of molecules, will enter through the microscopic hole in a few minutes' time—the hole being unaltered in size and the number of molecules undiminished. This apparent paradox can only be explained by again supposing the size of the molecules to be diminished almost infinitely, so that instead of entering at the rate of one hundred millions every second, they troop in at the rate of something like three hundred trillions a second. This sum has been done, but figures when they mount so high cease to have any meaning, and such calculations are as futile as trying to count the drops in the ocean.

In studying this fourth state of matter we seem at length to have within our grasp, and obedient to our control, the little indivisible particles which with good warrant are supposed to constitute the physical basis of the universe. We have seen that in some of its properties radiant matter is as material as wood, while in other properties it almost assumes the character of radiant energy. We have actually touched the border-land where matter and force seem to merge into one another—the shadowy realm between known and unknown, which for us has always had peculiar temptations. We venture to think that the greatest scientific problems of the future will find their solution in this border-land, and even beyond. Here, it seems to us, lie ultimate realities—subtle, far-reaching, wonderful.

"Yet all these were, when no man did them know,
Yet have from wisest ages hidden beene;
And later Times thinges more unknowne shall show.
Why then should witlesse man so much misweene,
That nothing is, but that which he hath seene?"

The Thermograph.

In the accompanying engravings is represented a thermograph for making a continuous graphical record of the variations of atmospheric temperature. Its principal parts are, as shown in Fig. 1, a mercurial thermometer open at the top of the tube, and having a battery wire entering its bulb; an upright cylinder revolving by clock-work, covered with paper ruled for degrees and hours; and a bar raised and lowered by mechanism driven by clock-work, furnished below with a needle entering the tube of the thermometer, and furnished with a pencil or point, driven forward by a small electro-magnet, when the circuit is closed by the needle entering the mercury and then making a mark upon the paper.

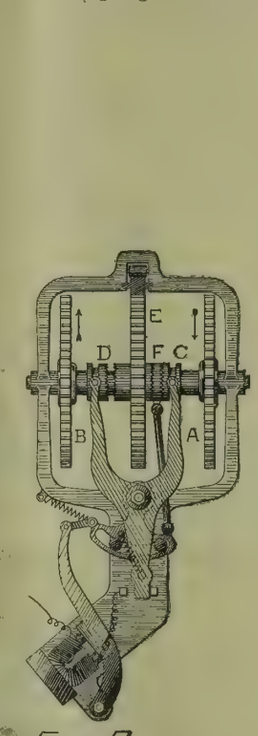


Fig. 2.

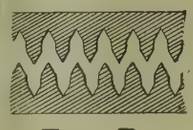


Fig. 3.

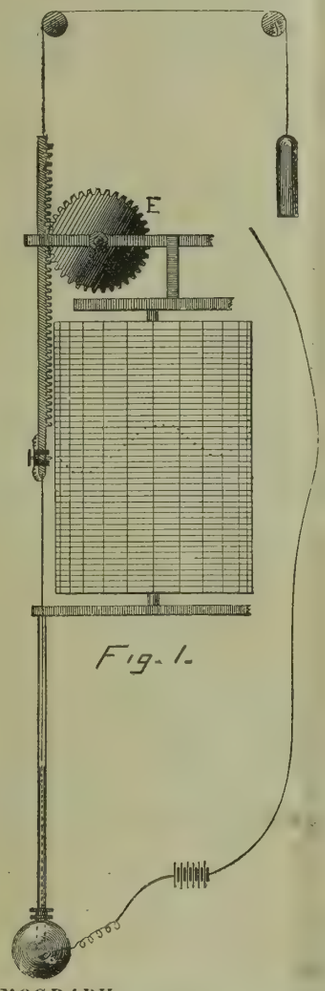


Fig. 1.

THE THERMOGRAPH.

The needle bar rises about half an inch from the point at which the needle leaves the mercury, and then descends until the needle again touches the mercury. when the point makes its mark upon the paper, and the bar again rises.

This is accomplished by the mechanism shown principally in Fig. 2, in which the wheel E (shown also in Fig. 1) gears into the needle bar; A and B are wheels driven by clock-work (not shown) running upon sleeves loose upon the shaft E; C and D are clutches, coupling respectively A and B to E. The levers actuating these two clutches unite and move upon a common pivot, from which point they extend as an arm, which is capable of a lateral movement between two stops, bringing one or the other of the clutches into action. Beneath the clutch arm is a pressure spring, one end of which presses against the end of the arm and the other against a plate moving upon the same pivot with the arm, which plate also is capable of a lateral movement between its stops. If this spring plate be moved in either direction to its stops, carrying with it the base of the spring, the clutch arm will be moved in the other direction, and the clutch on that line will be engaged, the wheel E being moved and the needle bar raised or lowered accordingly. F is a loose sleeve on the shaft E, having an arm which is connected by a drop-rod to the spring plate. When the clutch C is in action, as shown in the drawing, connecting the wheel A with the wheel F, and the sleeve F raises the needle bar, the arm of the sleeve F draws upon the spring plate and moves it over, and thus reverses the action of the clutches and the movement of the needle bar, which then descends.

When, by descending, the needle is brought in contact with the mercury and a circuit is made, the large electro-magnet draws upon its armature, which is attached to a lever, drawing the spring plate to its former position and causing the needle bar to rise. A draft spring on the same side of the spring plate supplements the action of the electro-magnet; and since the resistance of both these springs occurs only during the ascent of the needle bar, this is counterpoised to excess, and the resistance to and movement of the clock-work are thus rendered uniform.

The stop of the clutch arm next to the electro-magnet is an insulated plate, to which the battery wire is attached, so that as soon as the arm has left that stop the circuit is again broken, and the recording point is at once released.

The tube and bulb of the thermometer are made in two parts, the tube entering the bulb, so that by changing its position the capacity of the bulb may be varied and the motion of the mercury in the tube may be made to fit to a standard scale. The mercury is covered with oil, to prevent oxidation, and the whole apparatus, except the thermometer, is inclosed and protected from dust.

The system may also be applied to a barometric record.

The apparatus here referred to was designed by Mr. G. Morgan Eldridge, member of the Franklin Institute, and described by him in a paper read at a late meeting of that society.

Forbidding the Sale of Dangerous Kerosene.

The Board of Health of this State is desirous that public attention should be called to the Fenner law against the sale of illuminating oils below a certain standard. The law went into effect August 6th.

It provides that illuminating oils that give off an explosive vapor that will flash at a temperature below 100° Fah., shall not be used for lighting purposes; and that oils which ignite and burn at a temperature less than 300° Fah. shall not be used upon railway passenger cars nor upon vessels moved by steam. The only exceptions made to the use of oils that are below the standard, are those cases where they are controlled by mechanism that securely vaporizes them. Oils that are suspected to be below the standard are to be examined by the four analysts of the State Board of Health. That some examination of kerosene and other illuminating oils is necessary, is obvious. The newspapers daily contain the record of some accident from the explosion of oils below the standard. It should be said that the well-known dealers manufactured an oil above the standard before the passage of the law; and that the persons who manufacture dangerous oils are small dealers ambitious to make money quickly. Dr. Elisha Harris, the secretary of the State Board of Health, affirms what is well known to those who are at all familiar with the subject, that many of the oils advertised as non-explosive, are highly explosive. The board intends to strictly enforce the law, and will call the attention of 800 local boards to its provisions.

Any legal restrictions that will effect the object of preventing the use, for illuminating purposes, of dangerous products of petroleum, have our decided approval. It strikes us, however, that the exception made in favor of these lighter and highly inflammable products, "where they are controlled by mechanism that securely vaporizes them," is the weak point in the above named enactment. It is gravely to be doubted whether this will not prove the loophole through which dealers in adulterated products will be able to escape all responsibility, and the law fail to accomplish its protective object. The only method for securing the immunity of the public from the horrors of coal oil burnings and explosions, is to absolutely forbid the use for illuminating puposes of all oil that does not come up to the legal stand-

* The possible duration of the sun, from formation to extinction, has been variously estimated, by different authorities, at from eighteen million years to four hundred million years. For the purpose of this illustration we take the highest estimate.

† According to Mr. Johnstone Stoney, 1 c.c. of air contains about 1,000,000,000,000,000,000,000 molecules. Therefore, a bulb 13.5 centimeters in diameter contains $13.5^3 \times 0.5236 \times$ 1,000,000,000,000,000,000,000, or 1,288,252,350,000,000,000,000,000, molecules of air at the ordinary pressure. Therefore the bulb, when exhausted to the millionth of an atmosphere, contains 1,288,252,350,000,000,000 molecules, leaving 1,288,251,061,747,650,000,000,000 molecules to enter through the perforation. At the rate of 100,000,000 molecules a second, the time required for them all to enter will be 12,882,510,617,476,500 seconds, or 214,708,510,291,275 minutes, or 3,578,475,171,521 hours, or 149,103,132,147 days, or 408,501,731 years.

ard. No form of lamp has ever been devised to burn benzine or naphtha with safety, and it is doubtful if the invention of such a lamp is within the bounds of possibility; and the handling of such inflammable stuff, the filling of lamps by persons ignorant of its dangerously inflammable character, or careless of consequences, and the accidental breakage of lamps, cause far more accidents than the explosion of the lamps. The absolute exclusion of these light oils from use for illuminating purposes in any form of apparatus is the only safe course to adopt.

Absorption of Metallic Oxides by Plants.—Prof. F. C. Phillips, of the Western University (of Pennsylvania), has lately published an interesting review of this subject, about which very little is definitely known, and has added thereto the results of some experiments of his own.

Prof. Phillips in his paper refers at length to the experiments and conclusions of Dr. Freytag, of the Agricultural Laboratory of Bonn (Germany), made in 1870. This investigator found that the ashes of plants growing in the neighborhood of the copper smelting furnaces of Mansfield, contained considerable quantities of the oxides of copper and zinc—as much as 0.2 per cent of the former, and 0.36 per cent of oxide of zinc. In experiments instituted by Freytag, in germinating seeds in solutions containing arsenious acid, and the sulphates of iron, cobalt, nickel, zinc and copper, he found that a solution containing one-80th per cent of arsenious acid proved fatal, as was also the case with one-25th per cent of sulphate of cobalt, one-15th per cent of sulphate of nickel, one-50th per cent of sulphate of zinc, one-5th per cent of sulphate of iron. No injurious effects were produced by more dilute solutions, the plants continuing to thrive until the poisonous limit of concentration was reached, when they rapidly withered and died. Freytag thus sums up: "It has been fully demonstrated that plants are not capable of selecting from the substances presented to their roots; that they are, on the contrary, compelled to take up all matters alike which are in a form fitted for absorption, but that matters insoluble in the moisture of the soil are never taken up in sufficient quantities to endanger the life of the plant."

This conclusion had, however, been previously announced by Liebig in his "Agricultural Chemistry." Freytag notes, also, that of all the heavy metallic oxides, that of zinc appears to effect the least disturbance to the economy of plant life, and to be the most readily absorbed. He found that zinc added to soil in the form of carbonate is absorbed by rye, wheat and maize, and is deposited in the leaves, stems and seeds.

Phillips, in this connection, calls attention to the fact long since observed, that many plants growing near zinc mines absorb considerable quantities of oxide of zinc, and that in two well-known cases new varieties are believed to have been produced from the direct effect of the zinc in the soil; one of them is a shepherd's purse (*Thlaspi alpestre*, var. *calaminaris*), and the other a violet (*Viola tricolor*, var. *calaminaris*); the latter plant is by many botanists considered to be a distinct species. The ash of the leaves of this violet contains as much as 13 per cent of oxide of zinc. Both of these plants are confined to localities where zinc is an element of the soil, and there seems to be no reason to doubt that the variations they show are due to the influence of this metal. The fact appears to be, therefore, that zinc is readily absorbed by certain plants, and that it in nowise disturbs their nutrition.

Prof. Phillips records, finally, the results of a number of experiments conducted by himself, in which he tried the influence of carbonates of copper, zinc and lead and the arsenate of lime upon young and healthy plants. Without detailing the experiments, we simply append his conclusions, which are as follows: 1. That healthy plants grown under favorable conditions, may absorb through their roots small quantities of lead, zinc, copper and arsenic. 2. That lead and zinc may enter the tissues in this way without causing any disturbance in the growth, nutrition and functions of the plant. 3. That the compounds of copper and arsenic exert a distinctly poisonous influence, tending, when present in large quantity, to check the formation of roots, and either killing the plant or so far reducing its vitality as to interfere with nutrition and growth.

In the case of the heavy metals, copper, zinc, arsenic and lead, it seems to be probable that their oxides may, under certain circumstances, become deposited in the tissues of the plant. As to the manner in which this takes place authorities differ.

It is supposed by Freytag and others that plants absorb all soluble matters indiscriminately through their numberless rootlets, that the absorption of poisonous metals causes no disturbance until a certain degree of concentration is reached, when the plant rapidly withers and dies; that plants are therefore spared the sufferings of chronic poisoning, but are very susceptible to acute poisoning, which is invariably fatal. While it is held by others that plants absorb only such elements as are essential and nutritious, refusing to take up what is poisonous or unnutritious. Metallic compounds found in the analyses are, therefore, to be traced to atmospheric deposit adhering externally.

The theory of Freytag seems to have the weight of facts in its favor, and if it is possible that crops may become charged in this way with poisonous elements of the soil, it becomes a matter of the highest importance that wherever there is danger of such impregnation, the most efficient means be employed for its aversion, for soil once impregnated with copper, lead and zinc, may year after year bear crops poisoned in the same manner.

The practical bearing of the foregoing facts and conclusions will be very obvious to the intelligent reader, and they are very important. It is well known that poisonous substances, and especially Paris green—a salt containing arsenic and copper—are almost universally employed over large areas for the destruction of insects that infest and devour the growing plants. Since, now, it has been shown that plants do not possess the power of discriminating in the absorption of suitable elements from the soil, it becomes a matter for grave consideration whether the continuous use of such poisonous substances may not become a source of serious danger.

The Influence of Sanitary Science in reducing the death-rate is strikingly shown in official reports in which the annual death-rate in England and Wales is compared for the last four decades. It should be remarked, that in Great Britain unusual attention has been paid during this period to the introduction of plans and measures for improving the sanitary condition of cities and towns, and the results obtained fully justify the trouble and expense which this attention to sanitation has involved. The reports referred to show that in England and Wales the annual death-rate per 1,000 inhabitants was in the decade:

1841-50.	1851-60.	1861-70.	1871-80.
22.4	22.2	22.5	21.5

The death-rate, therefore, appears to have been about stationary, or but very slightly fluctuating during the first three periods, but shows a material falling off in the fourth and last. The reduction in the period 1871–80, as compared with that of the preceding period, shows a falling off of 1 in 1,000—a very small number when contemplated by itself, but one which represents the saving of no less than a quarter of a million lives, when taken in connection with the population of many millions which these countries possess.

Another point worthy of note, and which should not be overlooked in estimating the value of the results attained by the improved sanitation of the cities and towns of the countries named, is the fact that the actual number of deaths is but a fraction of the amount of disease and suffering. It is fair to assume that there are twelve cases of serious sickness for each case that terminates fatally. It follows, therefore, that in addition to the quarter of a million persons saved from death during the last decade, there must have been twelve times as many, or at least three million persons, spared the suffering and loss of time and money which would otherwise have been caused by sickness.

But what reason is there to suppose that the credit of the reformation is due to sanitary science? That sanitation is entitled to the credit is proved by the fact that the diseases in connection with which there has been the greatest reduction of mortality, are the zymotic diseases—those which are most speedily arrested by sanitary appliances, and most easily controlled by the action of sanitary authorities. What is still more remarkable, is the circumstance that half of the improvement under the zymotic diseases is due to fever—the disease which, as the report says, "more than any other shows itself in connection with such faults of drainage, of water supply, and of filth accumulation as it is within the province of good sanitary administration to remove." The figures which show this result are worth examination:

Annual death-rate per 1,000.	1851-60.	1861-70.	1871-80.
Seven zymotic diseases....	4.11	4.14	3.36
Fever alone.....	0.91	0.88	0.49

It thus appears that of the entire reduction of 1.0 per 1,000 in the death-rate of the last decade compared with the preceding one, more than three-fourths (exactly 0.78) is due to the fall in the seven zymotic diseases. It further appears that half of this decline exactly 0.39) is due to the fall in deaths from fever. When three-fourths of the improvement is clearly proved to have occurred in the domain within which sanitation can be most effective; and when, during these ten years, there has been great energy in the administration of all sanitary measures, it is surely fair to conclude that improved sanitation is entitled to a large share, if not the whole, of the credit of the remarkable amelioration. "It is particularly significant," adds the report, "that since the year 1870, when the fever death-rate was 0.80 per 1,000, it has fallen pretty steadily, year by year, down to 0.32 in 1880."

Formation of Coal from Marine Algæ.—The theory that the immense deposits of coal so widely distributed over the earth, had their origin in immense depositions of marine algæ, in contradistinction to the notion that they originated from accumulations of terrestrial plants, is now gradually meeting with acceptance by geologists. In our last issue we gave a brief *résumé* of the investigations and opinions of Prof. Reinsch on this subject, in which he strongly confirms the marine origin of the great coal deposits.

The theory that coal has been formed by the depositions of marine algæ, originated with the late Prof. Frederich Mohr, an eminent chemist and geologist, who advanced it in his interesting work entitled the "Geschichte der Erde," which appeared in the year 1866, and in which he supports this view of the origin of coal with many ingenious arguments, inferences and facts, many of which have since been confirmed.

The luxuriance of these forms of submarine vegetation in many portions of the oceans surpasses belief. At the present time, the Southern hemisphere appears to be the region in which they grow most luxuriantly, though they are widely distributed everywhere. In the Southern oceans, however, they abound. Mohr mentions some cases *apropos* of this which have been noted by Darwin. In the neighborhood of Terra del Fuego, for example, a fucus covered bank was passed

which had a depth of more than 24 fathoms. Since the leaves of the *Fucus giganteus* were buoyed up everywhere on the surface, this plant must have had stems longer than 144 feet, as they never grow up vertically, but always inclined at a high angle. Darwin compares the primeval woods of the South American continent with those of the bottom of the Antarctic sea, and declares the latter to be by far the grandest. So much for the abundance of this class of vegetation, which is more than sufficient to account for the immense deposits of coal.

There are other facts mentioned by Mohr which go to confirm this view of the origin of coal. One of the most noteworthy is the very small percentage of mineral matter in the majority of coals, which is very much less than that found in peat, lignite, etc., which are of terrestrial origin. Again, the considerable percentage of nitrogen found in coal, is a confirmatory fact. The distillation of coal invariably develops considerable quantities of ammonia, which is rarely developed from peat or lignite. This large proportion of nitrogen is referred by Mohr to the innumerable animals that lived on the sea tang from which he believes the coal was formed.

One other important fact that speaks in favor of the origin of coal from marine algæ, is the presence of bromine and iodine in coal soot, which was proved by Mohr and confirmed by Prof. Landolt. This fact is very significant, since the presence of these elements would seem to be a certain indication of a marine origin of the substances containing them. The great source of bromine and iodine is from the sea-weed (kelp) gathered from the sea-shores.

Taking these facts all together, they lend the strongest probability to the theory that the great coal beds originated from immense depositions of marine plants, and not, as has hitherto been very generally believed, from terrestrial vegetation.

A New Process for Preserving Meat.—The following process for preserving meat, which is known as the Jones process, presumably from the name of the inventor, was lately exhibited in London. It differs materially from previously suggested plans, and has sufficient interest from a scientific point of view to warrant careful attention.

Instead of steeping the meat, after slaughtering the animal, in an antiseptic or preservative preparation, as is practiced in other processes, in this method the preservative is introduced into the animal while it is still living, and by the action of the heart is pumped in a few minutes through the blood vessels and capillaries into every part of the body. The operation is thus described: The animal (in this case a sheep) was first stunned, to render it insensible to pain, by a smart blow on the head with a wooden mallet. The left jugular vein was then laid bare, and with the aid of a surgical trocar and canula about a pint of blood was drawn from it. The preservative solution, dissolved in water and kept at blood heat by means of a hot water-jacket surrounding the tin can in which it was contained, was then allowed to flow into the vein through a rubber tube placed to the orifice of the canula. About a quart of the liquid was permitted to run into the insensible animal, when the canula was closed with a plug, and about two minutes were allowed to pass to permit the injected fluid to be pumped by the heart through the whole vascular system. The animal was then stuck by the butcher in the ordinary way. The whole operation, from the time the animal was stunned, did not occupy more than five minutes.

The preservative used in this process is boracic acid. It is affirmed respecting this, that it does not impart the slightest taste to meat, nor impair its flavor. It is claimed also that by means of this method of treatment, a much more effectual impregnation of the flesh is obtained than by any other means; and that when prepared in this manner, meat can be kept for five or six weeks in summer, and from two to three months in winter, without showing any signs of putrefaction, and without the use of ice or refrigerators. The cost of the process is trifling, not exceeding 10 to 12 cents per animal treated; the apparatus required is of the simplest description, and the skill necessary to operate the process can be readily acquired.

Respecting the above, we may add, that while the general features of the process strike us most favorably, as being at once scientific, simple and effectual, it is doubtful if the use of boracic acid is entirely free from objection. This substance possesses antiseptic properties of a high order, and has often been suggested for the preservation of meat and other articles of food. The latest suggestion of this nature is that of Prof. Barff, whose so-called "boroglyceride" is now attracting considerable attention. It has been affirmed, however, that boracic acid, and its compounds, when taken into the stomach for some time, even in minute doses, originates serious disorders of the digestive system. It is possible that the danger from this cause may have been exaggerated, but until this is proved, it is worthy of careful consideration.

Curious Changes on the Planet Mars.—Astronomers have lately been much puzzled at certain remarkable changes that have been observed to be taking place on the surface of our neighboring planet Mars, and many speculations as to their real nature and significance have been ventured, though as yet they are mere vague guesses.

The changes here referred to first arrested the attention of astronomers at the time of the brilliant opposition of Mars in 1877, when his two satellites were discovered. It was then that the existence of a number of long, narrow streaks, forming a sort of net-work over his surface, was also discovered. At the subsequent opposition of 1879–80, Prof. Schiaparelli, director of the Observatory of Milan, detected these same long, narrow streaks crossing the Martian disk in all directions, and which, bearing more resemblance to canals than anything else, have since been so designated. These canals, Schiaparelli carefully examined, and made accurate drawings of them.

At the opposition of 1881–82, Schiaparelli again had an opportunity of making an examination of this remarkable feature of the Martian topography, and made some discoveries concerning them that are both curious and astonishing. He found, in the case of many of the canals of which he had made faithful drawings during his earlier observations, that they had become divided and subdivided by a number of parallel lines running through them.

The most singular discovery is yet to be named. He was enabled to actually observe the progressive development and duplication of these canals in about twenty instances, between the 19th of January and the 24th of February. From the eminence of the observer, there can be no doubt of the entire reliability of these astonishing observations. Schiaparelli has noticed other changes going on on the surface of our neighbor planet—notably, a considerable enlargement of one of the supposed oceanic bodies of Mars, known to astronomers as the Kaiser Sea, and the variable brightness of certain other regions.

The next opposition of Mars, which will take place on the 31st of January, 1884, will be anticipated with much interest by astronomers. Some of the great telescopes now in course of construction, will by that time have been completed and erected, and, in the hands of distinguished astronomers, it may be that the nature of the mysterious and pronounced changes now taking place on Mars may be unravelled. As they concern the celestial body, which, next to our own satellite, is nearest to the earth, the phenomena above noticed have universal interest.

Parchmenting Textile Fabrics.—In the *Textile Monitor* we notice an ingenious process for parchmenting textiles, from which we make the following abstract: The linen or cotton, or fiber, first thoroughly freed from all sizing and finishing ingredients, such as glue, starch, dextrine, etc., is passed through a bath containing a thin batter of paper pulp, of linen or cotton wasteage or uncalendered paper. The cotton or linen absorbs fibers from this pulp, which thus closes its pores. It is then passed through a pair of cylinders and subjected thereby to gentle pressure, which effects the thorough incorporation of the fibrous pulp with the fabric. From this the fabric is passed into a bath of concentrated sulphuric acid, made by adding 10 or 15 per cent of water to acid of 66° B. This bath should be kept at as nearly a uniform temperature as possible by suitable cooling contrivances, and should never be allowed to rise above 75° Fah. The fabric should be fed into the acid bath at a uniform rate of speed, and should remain immersed from 6 to 35 seconds, according to its thickness and density. From the acid bath the fabric is passed between two lead or glass rollers, for the purpose of expressing the superfluous acid from it; from these it passes into a series of troughs containing cold water, to remove as much of the acid as possible. From these it passes into a solution of ammonia, or carbonate of ammonia, to neutralize the last traces of acid that may adhere to the fabric. It is then washed to remove the ammoniacal smell by passing through more water, and finally is calendered by pressure between steel rollers, whereby all the pores of the fabric are thoroughly closed by the parchmented fibers which at the commencement of the operation were pressed into the fabric. As a finishing operation, the calendered fabric is passed between drying rollers, consisting of a pair of rollers covered with felt, flannel or pasteboard, and which are kept constantly in condition to absorb moisture by having another pair of copper or iron rollers, heated by steam, running in contact with them.

Thus prepared, the parchmented fabric is affirmed to excel ordinary fabrics of a similar nature by possessing greater strength and being water-proof. It is recommended for various purposes—water-proof clothing, water-proof coverings, machinery belting, etc.

Chemical Analysis of Tissues.—For the detection and quantitative estimation of silk, wool, linen and cotton fiber in tissues, the following process is recommended by Remont: Four samples of the questionable tissue, each weighing about 2 grams, are taken, and three of them are immersed in diluted muriatic acid containing about 3 per cent of the latter. Two of these samples are boiled with basic chloride of zinc, and one of them with a solution of caustic soda. The four samples are now dried and weighed. The difference due to the substance dissolved in muriatic acid is equal to the amount of starching and coloring matter; the amount of silk is shown by that portion dissolved in chloride of zinc, while that soluble in caustic soda stands for wool. That portion insoluble in any of these agents is considered as vegetable fiber after 5 per cent have been added to the same, which experience has shown to be an unavoidable loss. The solution of basic chloride of zinc is obtained by dissolving 1,000 parts of fused chloride of zinc in 850 parts of water, after which 40 parts of oxide of zinc are added.

Advantage of Rapid Filtration.—Mr. F. Casamajor, in a recent communication to the *Chemical News*, calls atttention to an important advantage of rapid filtration over the old, slow way, which we do not remember to have ever seen stated. It is this: Most precipitates are soluble in water, although not appreciably soluble in the liquid in which precipitation takes place. When filtration is very slow, the water used for washing, in going through the precipitate, is long enough in contact with it to be enabled to dissolve an appreciable quantity of it; while, on the contrary, with rapid filtration, the water passes through so quickly that it has not time to dissolve an appreciable quantity. This fact, Mr. Casamajor, says in conclusion, combined with more thorough washing, insures greater accuracy.

The New England Manufacturers' and Mechanics' Institute Fair.

As supplementary to our several notices of the forthcoming second annual fair of this admirably organized and enterprising institution, we print with this an engraving showing a perspective view of the exhibition building. The structure is quite an imposing one, and as regards size and internal arrangement is excellently adapted for the holding of a large exhibition.

The institute building is said to be the largest permanent edifice ever erected in New England. It is in the form of a parallelogram, 403 feet 4 inches wide and 551 feet 6 inches in depth, thus embracing an area of 351,834 square feet. The front of the building is ornamented with two towers, each 30 feet square and 86 feet in hight. Extending back from the front to a depth of 104 feet, and 252 feet in width, is a hall having a seating capacity to accommodate 10,000 persons, and the platform of which is raised above the floor of the principal exhibition space.

THE NEW ENGLAND MANUFACTURERS' AND MECHANICS' INSTITUTE EXHIBITION BUILDING.

Beyond the hall is the nave, 126 feet in width, and extending to the rear of the building. Extending around the hall is a gallery 63 feet in width, which is also utilized for exhibition purposes. The roof is of iron and glass, and the roof trusses, galleries and supporting columns are of iron.

The internal appointments, the lighting of the building, the distribution of power, for machinery in motion, provisions for restaurant, retiring-rooms and the like, have received careful attention, and leave nothing to be desired.

The railroad exhibit at this fair will be as interesting and fully as large as that of Atlanta last year. The individual exhibitors from the South will be quite large. In addition to the Southern railroads already announced to exhibit, is the Louisville and Nashville. Cities along the lines of the following railroads will also probably exhibit, although definite arrangements have not as yet been made: The Norfolk and Western, East Tennessee, Memphis and Chesapeake, and the Shenandoah Valley. All the railroads terminating in Boston have given notice that they will return all exhibits to the original exhibitors free of charge, which is practically half rates for the exhibitors. The United States and Canada and the American Express companies have given a like assurance, and there is a strong probability that others will do the same.

The following resolve, recently passed by the Richmond Chamber of Commerce, is self-explanatory: "*Resolved*, That the manufacturers of Richmond are requested to exhibit their products at the fair of the New England Manufacturers' and Mechanics' Institute, which will be held in Boston from Sept. 6th to Nov. 1st. It is understood that many Southern products and manufactures will be exhibited there, and it is desirable for Richmond to be well represented, thus showing the rapid advance we have made in material prosperity in the past sixteen years."

With a building so admirably adapted for exhibition purposes, with the prestige of its last year's remarkable success, and with the well-known energy and enterprise of its management, we have no doubt that the coming exhibition will shed fresh luster upon the name and fame of the New England Manufacturers' and Mechanics' Institute.

Annealing Chains.—It cannot be too much insisted upon that chains of cranes, or those used for other purposes, should be regularly and periodically inspected. As all chains are liable to become brittle by use, they should be annealed once a year, by heating them in a furnace uniformly to a dull red heat, and then allowing them to cool very slowly.

The Theory of Steam Boiler Explosions.

BY JOHN W. NYSTROM.

In connection with the records of Mr. Lawson's experiments on steam boiler explosions, published in the Manufacturer and Builder, and his invention to prevent such explosions by interposing a perforated diaphragm, it is proposed to offer some hypotheses bearing upon that subject.

From the result of steam boiler explosions, twisting and tearing to pieces strong and sound iron, it is evident that some force, greater than that due to the primitive or normal steam pressure, has been acting; and it has always puzzled observers where such extra force could come from. Knowing the steam pressure and quantity of water in a boiler, we can easily determine the quantity of work stored therein, but that does not settle satisfactorily the question of the great force which has evidently been acting in the explosion.

It is well known that when bodies are rubbed against one another the consequent friction generates heat, corresponding to the amount of work expended in the rubbing. When liquids are agitated, they become overheated, corresponding to the amount of work expended in the agitation, as exemplified by Joule's experiments in agitating water, by which he determined the dynamic equivalent of heat. The Niagara Falls generates steam even on the coldest winter day, by the agitation of its waters. Steam, as well as all other vapors and gases, are overheated by wire-drawing, and so are also ductile metals when drawn into wire. Good wrought iron can be heated red hot simply by rapid hammering, without application of heat. The grinding of metals on emery wheels produces sprays of fire sparks.

It is possible, and even probable, that all heat is produced by friction, and that thus we may account for the convertability of heat into work. The act of chemical combination of simple substances generates heat by the force of affinity rubbing the atoms against one another. The greater the force of affinity between the substances is, the more the heat and the higher the temperature generated by the act of combination or combustion.

A steam boiler full of water and steam of pressure say 100 pounds to the square inch above vacuum, will contain 17,000 units of heat per cubic foot of the enclosed water; and when the steam pressure is suddenly removed from the water surface by the bursting of the boiler, the heat suddenly converts the whole body of water into the form of a foam, which very violent disturbance generates more heat, and consequently raises the temperature and steam pressure far above that of the normal condition. This is probably the cause of disastrous steam boiler explosions; but it is not the cause of the first bursting of the boiler.

It may now be asked if heat can generate more heat than itself? which question can be answered by the law of thermo-dynamics.

Suppose the steam to work the piston in a cylinder only one single stroke, and the steam to remain in the cylinder without being exhausted. The work done by that steam can be applied to compression of air, which generates heat, although there is no heat lost in the steam enclosed in the cylinder. When the work of the heat is applied to convert water into foam, then the additional heat produced by that work remains in the foam. The opening of a throttle valve,

as is done in the Lawson experiments, I do not think can be so effective as the bursting of the boiler would be in producing a grand explosion.

It is not clear to me how Mr. Lawson's diaphragm can prevent steam boiler explosions.

Market Report of Building Materials.

NEW YORK PRICES.

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LUMBER.

Pine, very choice and extra dry, ₱ M	$60 00 @ 70 00
Pine, good	55 00 @ 60 00
Pine, shipping box	21 00 @ 22 50
Pine, common box	18 00 @ 20 00
Pine, common box ⅝	16 00 @ 18 00
Pine, tally plank, 1¼, 10 inch, dressed each	— 44 @ — 50
Pine, tally plank, 1¼, 2d quality	— 35 @ — 38
Pine, tally plank, 1¼, culls	— 28 @ — 30
Pine, tally boards, dressed, good	— 30 @ — 32
Pine, tally boards, dressed, common	— 25 @ — 28
Pine, tally boards, culls, dressed	— 23 @ — 25
Pine, strip boards, merchantable	— 18 @ — 20
Pine, strip boards, clear	— 24 @ — 26
Pine, strip plank, dressed, clear	— 33 @ — 35
Spruce boards, dressed	— 25 @ — 27
Spruce plank, 1¼ inch, dressed	— 28 @ — 30
Spruce plank, 2 inch	— 43 @ — 45
Spruce wall strips	— 15 @ — 16
Spruce timber, ₱ M	20 00 @ 25 00
Hemlock boards, ₱ M	17 00 @ 18 00
Hemlock joist, 2½x4, each	— 16 @ — 17
Hemlock joist, 3x4	— 18 @ — 20
Hemlock joist, 4x6	— 40 @ — 44
Ash, good, ₱ M	55 00 @ — —
Oak	60 00 @ 65 00
Maple culls	25 00 @ 30 00
Maple good	45 00 @ 50 00
Chestnut	48 00 @ 52 00
Cypress, 1, 1½, 2, and 2½-inch	35 00 @ 40 00
Black Walnut, good to choice	115 00 @125 00
Black walnut, ⅝-inch	85 00 @100 00
Black walnut, selected, and seasoned	150 00 @175 00
Black walnut, counters, ₱ ft	— 22 @ — 28
Cherry, wide, ₱ M	100 00 @120 00
Cherry, ordinary	60 00 @ 80 00
White wood, inch	45 00 @ 50 00
White wood, ⅝-inch	35 00 @ 40 00
White wood, ⅝ panels	45 00 @ 50 00
Shingles, extra sawed pine, 18-inch	4 00 @ 5 00
Shingles, clear sawed pine, 16-inch	3 75 @ 4 00
Shingles, cypress, 24x6	18 00 @ 20 00
Shingles, cypress, 20x6	10 00 @ 12 00
Lath, Cargo rate	2 00 @ — —
Yellow dressed pine flooring	30 00 @ 40 00
Yellow pine girders	32 50 @ 40 00
Locust posts, 8 feet, ₱ inch	— 18 @ — 20
Locust posts, 10 feet	— 24 @ — 25
Locust posts, 12 feet	— 29 @ — 34
Chestnut posts, ₱ ft	— 3 @ —3½
Basswood ₱ M	25 00 @ 30 00

Cargo rates 10 ₱ cent off.

CEMENT—PER BARREL.

Portland (imported)	2 65 @ 2 85
Portland (American)	2 30 @ 2 75
Portland (Lafarge)	3 30 @ 3 65
Lime of Teil	2 30 @ 2 50
Lime of Teil, ₱ ton	15 00 @ 18 00
Roman	2 75 @ 3 25
Keene's & Martin's, coarse	6 00 @ 6 50
" fine	10 50 @ 10 75
Rosendale	1 05 @ 1 15

SOLDERS.

Half and half	16½ @ — 16¾
Extra	15½ @ — 15¾
No. 1	14 @ — 14¼

ZINC.—Duty, sheet, ₱ ℔, 2½ cents.

Sheet (cask) ₱ ℔	7¼ @ — 7½
Sheet (open)	8 @ — 8¼

BRICKS.

	Cargo.		Afloat.
Pale, ₱ M	4 00	@	4 50
Up Rivers	5 00	@	6 25
Jersey	5 00	@	5 75
Haverstraw Bay	6 25	@	6 50
" " choice	6 75	@	7 00
Favorite Brands	7 25	@	— —
Hollow Fire-Clay Brick	9 00	@	9 25

FRONTS.

Croton—Brown, ₱ M	11 00	@	12 00
" Dark	12 00	@	14 00
" Red	12 00	@	14 00
Philadelphia, on pier	23 00	@	25 00
Trenton "	23 00	@	25 00
Baltimore "	38 00	@	40 00
Clark's Glens Falls, White	30 00	@	— —
" " Red Fronts	27 50	@	— —
" " Molded Red and White	45 00	@	80 00

Yard prices 50 cents ₱ M higher, or with delivery added $2 ₱ M for hard and $3 ₱ M for front brick. For delivery add $5 on Philadelphia, Trenton and Glens Falls and $6 on Baltimore brick.

STONE.—Cargo Rates Delivered in New York.

Amherst Sandstone, No. 1, buff. in rough, ₱ c. f.	1 00 @ — —
do do No. 2	— 85 @ — 95
Bedford Stone	1 25 @ — —
Berlin Freestone, in rough	— 75 @ 1 00
Berea Freestone, in rough	— 75 @ 1 00
Brown Stone, Portland, Conn	1 00 @ 1 35
Bay of Fundy Wood Point Brown Stone	1 00 @ — —
do Mary Point Brown Stone	1 00 @ — —
do do Olive Stone	1 00 @ — —
Brown Stone, Belleville, N. J	1 00 @ 1 35
Granite, rough	— 60 @ 1 25
Canaan Marble	1 25 @ 1 50
Sutherland Falls Marble	1 25 @ 1 75
Dorchester, N. B., Stone, rough, ₱ foot	1 00 @ — —

LEAD—PER 100 POUNDS.

German	— — @ — —
English, common	— — @ — —
Spanish	5 75 @ — —
Foreign, refined	— — @ — —
Bar	6 50 @ — —
Sheet	7 50 @ — —
Pipe	— — @ — —
Domestic	4 63 @ — —

TIN PLATES.—Duty, 1⁷⁄₁₀ cents ₱ ℔.

I. C. charcoal, 10x14, ₱ box	6 25 @ 6 50
I. C. coke, 10x14	5 25 @ 5 75
I. X. charcoal, 10x14	8 25 @ 8 37½
I. C. charcoal, 14x20	6 25 @ 6 50
I. X. charcoal, 14x20	8 25 @ 8 37½
I. C. coke, 14x20	5 25 @ 5 75
I. C. coke, terne, 14x20	5 25 @ 5 37½
I. C. charcoal, terne, 14x20	5 50 @ 5 75

NAILS—PER KEG.

10d to 60d, common, fence and sheathing	3 30 @ 3 40
8d and 9d, common	3 65 @ — —
6d and 7d, common	3 90 @ — —
4d and 5d, common	4 15 @ — —
3d and 4d, light	4 95 @ — —
3d, fine	5 65 @ — —
2d, fine	5 65 @ — —
Cut spikes, all sizes	3 65 @ — —
Clinch nails, 1½ to 1¾ inch	5 65 @ — —
do. 2 to 2¼ inch	5 40 @ — —
do. 2½ to 2¾ inch	5 15 @ — —
do. 3 inch and longer	4 90 @ — —

IRON—PER TON.

Duty.—Bar, 1 to 1⅛c. ₱ ℔. ; Railroad, 70c. ₱ 100 ℔. ; Boiler and Plate, 1½c. ₱ ℔. ; Sheet, Band, Hoop, and Scroll, 1¼ to 1¾c. ₱ ℔. ; Pig, $7 ₱ ton ; Polished Sheet, 3c. ₱ ℔. Galvanized, 2½c. ₱ ℔. ; Scrap cast, $6 ₱ ton ; Scrap Wrought, $6 ₱ ton—all less 10 ₱ cent. No Bar Iron to pay a less duty than 35 ₱ cent ad val.

Pig, Scotch—Coltness	26 75 @ 27 75
" Glengarnock	24 50 @ 25 00
" Eglinton	23 00 @ 24 00
" American, No. 1	26 00 @ 26 50
" American, No. 2	24 00 @ 24 50
" American forge	22 50 @ 23 00

PAINTS.

Carmine, American, ₱ ℔	5 00 @ 5 25
Chalk, ₱ 100 ℔s	— 35 @ — —
China Clay, ₱ ton	18 00 @ 20 00
Chrome yellow, dry, ₱ ℔	— 12½ @ — 28
Lead, red American, ₱ ℔	— 6¾ @ — 7
Lead, white American, pure, in oil	— 7½ @ — 8
Lead, white American, pure, dry	— 6¾ @ — 7
Lead, white English, pure, in oil	— 9 @ — 10
Litharge	— 6¾ @ — 7
Ocher, Fr., dry, ₱ 100 ℔s	1 50 @ — —
Ocher, ground, in oil, ₱ ℔	— 6 @ — 15
Ocher, Vermont, ₱ 100 ℔s	— 75 @ 1 00
Orange Mineral, English	— 9 @ — 10
Paris White, American	— 1½ @ — 1¾
Paris White, English, prime	— 2 @ — 2¼
Paris Green	— 15 @ — 28
Plumbago paint, patent, ₱ ℔	— — @ — 25
Putty, ₱ ℔	— 2 @ — 2½
Spanish Brown, dry, ₱ ℔	— 1⅛ @ — 1¼
Spanish Brown, ground in oil, ₱ ℔	— 8 @ — 9
Venetian red, ₱ cwt	1 75 @ 2 00
Vermilion, Chinese, ₱ ℔	— 85 @ — 90
Vermilion, Trieste	— 70 @ — 75
Vermilion, quicksilver, bags	— 50 @ — 52½
Vermilion, American, common	— 15 @ — 18
Whiting, ₱ 100 ℔s	— 60 @ — 80
Zinc, white American, dry, No. 1	— 5 @ — 7½
Zinc, white American, No. 1, in oil	— 8 @ — 10
Zinc, white French, dry, (Red Seal,)	— 7 @ — 8
Zinc, white French, in oil	— 10 @ — 10½

VARNISHES—PER GALLON.

American Wearing Body	3 50 @ 4 00
Coach Body	2 35 @ 3 50
" "	1 80 @ 2 00
Furniture	1 25 @ 2 50
Black Asphaltum	1 00 @ 1 50
Brown Japan	1 00 @ 1 20
Liquid Paint Dryer	1 35 @ 1 75
Harness, (black)	3 00 @ 4 50
Shellac, Spirits	3 00 @ 3 50

LIME—PER BARREL.

State, common	— 85 @ — —
" finishing	1 15 @ — —
Rockland, common cargo rate	— 90 @ — —
" finishing	1 10 @ — —
Ground	— 85 @ — 90

Add 25 cents to above figures for yard rates.

HAIR.

Cattle, ₱ bushel of 7 ℔s	— 20 @ — 21
Goat " "	— 30 @ — 35

SLATE.

Purple, roofing slate, ₱ square	$6 00 @ 7 00
Green Slate	6 00 @ 7 00
Red Slate	13 00 @ — —
Black Slate, Pennsylvania, (at Jersey City)	4 75 @ 5 25
Slate tiles, 1¼-inch, rubbed, ₱ square foot	— 20 @ — 25

PLASTER PARIS.

Duty.—20 ₱ cent ad. val. on calcined ; lump free.

Calcined, ordinary city, ₱ bbl	1 25 @ 1 35
Calcined, city casting	1 50 @ 1 65
Calcined, city superfine	1 70 @ 1 75

MAHOGANY.

St. Domingo, crotches, ordinary to good, ₱ ft	— 15 @ —28
St. Domingo, crotches, fine	— 20 @ —30
St. Domingo, logs, small	— 5 @ —38
St. Domingo, logs, large	— 12 @ —15
Frontera, Mexican, large	— 12 @ —15
Frontera, Mexican, small	— 6 @ — 8
Other Mexican	— 6 @ —12½
Honduras	— 6 @ —12½

ROSEWOOD.

Rio Janeiro, ordinary to good, ₱ ℔	— 2½ @ — 4½
Rio Janeiro, good to fine	— 5 @ — 8
Honduras	— 6 @ — 12½
Satin Wood, ₱ foot	— 15 @ — 75
Tulipwood, ₱ ℔	— 6 @ — 7
Lignumvitæ, large, ₱ ton	30 00 @ 50 00
Lignumvitæ, other sizes	10 00 @ 25 00

CEDAR.

Cuba and Mexican, small, ₱ super. ft	6 @ — 7½
Cuba and Mexican, medium	8 @ — 9½
Cuba and Mexican, large	10 @ —11
Florida, ₱ cubic foot	40 @ —75

DEADENING AND ROOFING MATERIAL.

Mineral wood for Roofs and deadening, ₱ ℔	— 1¼ @ —1½

LABOR.

Ordinary, ₱ day	2 00 @ 2 50
Masons, do	3 50 @ 4 00
Plasterers, do	4 00 @ — —
Carpenters, do	4 00 @ — —
Plumbers, do	4 00 @ 4 50
Painters, do	3 00 @ 3 50
Stone-Cutters, do	3 00 @ 3 50

REVIEW OF THE MARKETS.—In the lumber market, so far as our local and near-by demand is concerned, there has been little if any improvement during the past month, and the shipping call has also been light, giving the general market a continued slow tone on the distributive side. In a wholesale way, however, or rather in the matter of demand from dealers, signs of improvement are becoming more prominent, and it commences to look as though the long-hoped-for turn of the market had at last been reached.

In the lime market demand has been without much animation, and somewhat irregular in form, but still on the whole has managed to make an outlet for about all receivers have had to offer and keep the market steady on a basis of 90 cents for common and $1.10 for lump.

In the brick market common hards have retained many of the leading features noted for some time past, a liberal offering finding a fairly balancing outlet and values undergoing no decided change. Pale brick, so far as can be learned, have kept sold up pretty clean and without much effort on the part of receivers, with the line of valuation still placed at $4 to $4.50 per M. Fronts generally have been quoted as firm, and meeting with a good average demand.

In the lath market supplies have not been very large, and about all arriving appeared to be wanted as soon as deliveries could be made. Some little irregularity on prices was developed, however, with sellers securing no great advantage, while buyers have claimed an easing off upon the line of value. Offerings to arrive have been moderate, and apparently made with indifference.

In the metal markets American pig has favored the selling interest, a quiet but steady movement exhausting supplies about as fast as they became available, and the bids ranging well up to former rates in all cases, the close ruling firmly on the various grades. Scotch pig has sold readily for both prompt and near-by future delivery; and while the orders have been in the main for comparatively small lots, they appear to have exhausted pretty much everything close up to the offering. Manufactured iron has been held firmly and the supply offering not abundant. Domestic pig lead has been steady and a fair business doing. Pig tin has been disturbed somewhat by variable advices from abroad, but not to any serious extent, and holders in most cases express confidence for the future. Tin plates have not moved to any extent beyond the regular jobbing call; but this has kept a fair amount of stock in motion, and values have been well maintained on all grades. Sheet zinc has been in fair request and steady.

In the nail market demand has been slightly irregular in character, but has lost little or nothing in volume, and most operators express satisfaction over the condition of the market.

In the paint market trade has not as yet reached any important volume on paints, colors, etc., but there has been a steady inclination to growth, and we find jobbers, at least, in a cheerful mood. Some of the wholesale operators complain slightly over the condition of the market, but are hopeful of an early improvement, and no effort is made to hurry matters beyond their natural development, while, as a rule, values are held up with some firmness.

A NEW BRANCH OF SILK MANUFACTURE.—A new and curious branch of silk manufacture has started into life in Paterson, N. J. The mode of manufacture is a secret, and is very closely guarded. Only the weavers possess the secret. The weaving is of a very high order, and those employed earn very high wages. The goods produced are made up to perfectly imitate sealskin. The process is entirely dissimilar from that of making plush and velvets. The goods in appearance are said to puzzle experts. If this statement is correct, a patent had better be risked than secrecy in manufacture.

The Tenth Cincinnati Industrial Exhibition, 1882.

We print herewith a fine illustration of the splendid building erected by the enterprise of the business men of Cincinnati for exhibition purposes, and which has no superior in the country. The city of Cincinnati, through the joint coöperation of its Chamber of Commerce, Board of Trade, and the Ohio Mechanics' Institute, has successfully held nine important exhibitions of arts and manufactures, to the great benefit of the participating exhibitors and to the credit of the city. These exhibitions have all been distinguished by the spirit of fairness and dignity that has characterized them, and have come to be regarded by the leading manufacturers of the whole country, who have learned to appreciate their advantages, as one of the leading industrial events of the year.

The tenth annual exhibition, under the same careful and dignified supervision that has characterized

CINCINNATI INDUSTRIAL EXHIBITION BUILDING.

the previous exhibitions and given them character, will be opened to the public on Wednesday, September 6th, and will continue until Saturday, October 7th, 1882. The management has every reason to anticipate that the coming exhibition will surpass in extent and importance all previous exhibitions.

Intending exhibitors are invited to make immediate application for information respecting the rules and regulations relating to the exhibition, to Wm. H. Stewart, Secretary Tenth Cincinnati Industrial Exhibition, Cincinnati, Ohio.

Fletcher's Formula for Cold Soldering.

Mr. Fletcher, of Warrington, England, whose name will be recalled by many of our readers in connection with his valuable improvements in gas furnaces and chemical apparatus, proposes the following method for soldering without the aid of heat. Many formulas for this purpose have been proposed from time to time, but when put to the test are usually unsatisfactory. We give the following because of our favorable knowledge of its proposer. The operation demands the preparation of a flux and a solder, the directions for preparing which are given herewith:

Flux.—One part of metallic sodium to 50 or 60 parts of mercury. These combine on being shaken in a bottle; or the amalgam may be bought from any dealer in chemical supplies. It must be kept in a well stoppered bottle to exclude the air, which would otherwise oxidize the mass. It has the property of amalgamating (equivalent to tinning by heat) any metallic surface, cast iron included.

Solder.—Make a weak solution of sulphate of copper, about an ounce to a quart of water. Precipitate the copper by rods of zinc; wash the precipitate several times with hot water, drain the water off, and add for every 3 ounces of precipitate 6 or 7 ounces of mercury; add also a little sulphuric acid, to assist the combination of the two metals. When combined, they form a paste which sets intensely hard in a few hours. It should be made, while still pasty, into small pellets.

When required for use, one or more of these pellets should be heated until the mercury oozes out from the surface in small beads; these should be shaken or wiped off, and the pellet rubbed in a mortar with a pestle until it forms a smooth, soft paste. When this is put on a surface that has been previously amalgamated with the sodium-mercury amalgam, it adheres firmly and sets very hard in a few hours. The joint can be parted, if necessary, either with a blow of the hammer or with the cold chisel, or by a heat about sufficient to melt plumbers' solder.

The Thermometer Fallacy.

There is a good deal of general misapprehension about the thermometer; and few even of those who know the fact that our feelings respecting comfort or discomfort depend much less upon the actual state of the thermometer than upon whether or not the atmosphere is dry or loaded with moisture, are apt to consider it. One is generally vastly more comfortable with the thermometer trying to touch zero, on say a clear, bright January day, than on a damp, chilly day of say March, though the thermometer may not register below 40°. The reason is easy to understand. The moisture with which the March air is laden has about four times the capacity of absorbing heat from surrounding objects that can yield it, than if it were perfectly dry. Consequently, when it strikes the body, it chills far more effectually than the comparatively colder dry air of midwinter.

So too in summer, the days of greatest discomfort are not those on which the thermometer registers the highest. That this is generally understood will be apparent from the fact that many will speak of a particularly sultry and uncomfortable day, such as those we had only a few weeks ago, that wilt collars and cuffs in a particularly prompt and aggravating manner, and that leave even the slightest remnant of clothing that the law allows one to carry, in that state of discomfort that we describe as "stickiness," and will express surprise that, though the thermometer does not rise nearly as high as it had done perhaps yesterday, they nevertheless feel the heat vastly more oppressive.

Here again the explanation of the circumstance is readily understandable. On the hot and comparatively dry day we perspire freely, and the perspiration is rapidly removed from the surface of the body by evaporation, which, as our readers need not be told, is a cooling process. The surface of the body is thus kept comparatively dry and comfortable. The close and oppressive feeling we have on a hot summer day is due to the fact that perspiration is not readily removed from the body, because the air is already charged perhaps almost to saturation and can take up no more. The perspiration clings to the skin, we lose the pleasant sensation of rapid evaporation from the body, and have the sensation of clamminess and discomfort.

Foreign Exhibitions.

It has been arranged to hold an International Electrical Exhibition in Vienna. In consideration of the fact that exhibitions of this nature are to be held this year in Munich and in Trieste, it has been decided to postpone the Vienna one until August, September and October, 1883.

The Bavarian National Exhibition of Industry, Art and Science is open in Nuremberg. The Nurembergers have been able to associate the marvels of industry and the treasures of art with the trees and turf of the fine park, having also the additional advantage of the electric light for the illumination of the gardens by night, which seems to be a specially popular feature.

To Make Wood-Work Incombustible.

It is said that wood-work of any kind may be made incombustible by painting it with several coats of a solution of silicate of soda, and finishing off with a mixture of this solution and sufficient common whiting to make it about as thick as ordinary paint. Wood treated in this way will not take fire from mere contact with flame; it requires to be heated until destructive distillation begins. Then, of course gases are given out which ignite, and the wood is gradually converted into charcoal; but until such distillation takes place the coated wood will not support combustion.

Valuable Decorative Process.

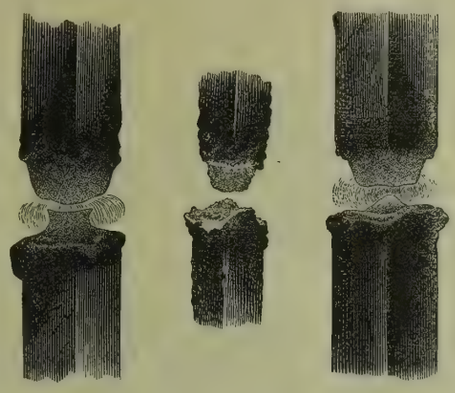
An English firm has brought into use a method for staining white woods in various patterns, in imitation of inlaid woods, which is simple and effective. It might profitably be adopted by American manufacturers of pine or "painted" furniture, which could be finished in its natural shade and decorated in colors by this method with great effect. In fact, there is a fine opening in the use of color decoration for pine furniture, and the manufacturer with enterprise enough to seize the opportunity will reap a good harvest. The method is as follows:

The surface to be decorated is made as smooth as possible. It is then covered with one or two coats of size, prepared by adding glue size of just sufficient strength to form a jelly, a little egg albumen and a small quantity of alum. When this is dry and thoroughly hard, the design must be traced or pounced upon it. The outline, and those lines separating the different parts of the design, and all other parts that are to remain the natural color of the wood, are then carefully painted in with Brunswick black or Canada balsam, laying on the black with a good body. This should remain until it gets thoroughly hard, which will be in about six or seven hours. The surface is then washed with a sponge and lukewarm water, until all the size is removed from the exposed parts, the pattern drawn in the Brunswick black, which is impervious to water, remaining intact, and serving to prevent the stains running together when applied. This washing must thoroughly remove all the size preparation, and after the wood has been allowed to dry it will be ready for the application of the colored stains. If the painting has been properly done the design will appear as a clear black outline, the white spaces in which are to be filled in with various colors, after which the black outline is to be removed, as will be explained. The black lines should be fully a sixteenth of an inch wide, and wider if required. Having decided upon the woods to be imitated and the colors to be used, the stains, which may be either spirit stains or water stains, or both, may be laid in. The lightest stains must be put in first, and need not be confined to the exact outline of that particular part, but it is as well that they should be. The stain may be freely used, and laid as level as it will allow, but a little shadiness is not at all objectionable. The next darkest stains may now be proceeded with, and so on for as many stains as are desired. When all are dry and hard, the black outline may be washed clean off the wood with a brush and turpentine, which may be used freely until the whole of the Brunswick black is removed. The various colored stains will then appear inclosed in a white outline, which, if properly done, will be sharp and clean and clear as an inlay of the real woods. What grain the white wood has will be more or less seen through the stains as they may be light or dark. The work may then be French polished or varnished.

Danger in False Hair.—Attention is called by the *Lancet* to the danger of the trade in false hair. It seems that the demand exceeds the supply. Europeans will not sell their hair, or have not enough to sell. Dealers, therefore, go for the material to Asia Minor, India, China and Japan. But the hair to be had there is mostly black, and to fit it for the Western market it is first boiled in dilute nitric acid to deprive it of its original color, and it is then dyed to suit the fashion of the time. This operation has been found to give rise to severe coughs, bronchitis, and other complaints, as the workmen breath the nitrous vapors which escape from the caldrons. The *Lancet* strongly objects to hair-dressers indulging in amateur dabbling with dangerous chemicals, especially nitric acid.

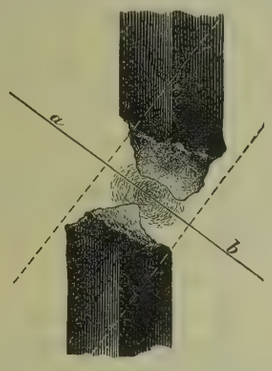
The Electric Light.

In continuation of our popular explanations respecting the electric light in our last number, we

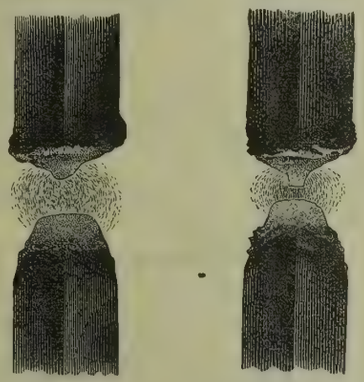


make herewith a few remarks on the causes which affect the amount of light which the carbons yield when in continuous service for hours.

Most of our readers who have had the opportunity of observing, or have taken the trouble to observe, the action of the electric light, have noticed the frequent unsteadiness of the light emitted from the carbon pencils. The principal cause for this, as we endeavored to explain in our former article on the sub-



ject, is the dropping off of the stalagmitic deposits of particles carried from the positive carbon to the negative, by the action of the current, and which, as they gradually built up, grew narrower at the base, as shown in our former cuts, until by a weakening of the current by this action, and the consumption of the upper carbon, the piece would drop off and the



lamp readjust itself. The effect of this action is distinctly perceptible to those who have taken the trouble to observe the electric light where the opportunity was afforded, but is only instantaneous, though often repeated. It is appreciable to a close observer for a few seconds before and after the readjustment of the lamp by the regulator.

The several illustrations given herewith shown the course of this action better than our former engravings. They are all from the Brush machine, and are literal copies of photographs of the light of the Brush system as reported upon by a very competent committee of the Franklin Institute.

This committee called attention in their report, among other things, to the fact that one of the most important conditions necessary to insure a maximum and uniform emission of light, was the relative position of the carbon points, showing how important it is that the axes of the two sticks or pencils of carbon shall be in the same line, so that the light produced shall be projected equally in all directions. Where the axes of the carbon pencils are not carefully maintained in the same line, more light is thrown in one direction than in another, and this difference, where the deviation from the proper alignment is great, may be very noticeable. It is sufficient here to mention this fact in connection with the cuts, in order to illustrate it.

Dickens' Ideal of a House.

In the course of a paper on "Ideal Dwelling-Houses," recently read before the Architectural Association, Mr. E. Ingress Bell referred to Dickens' "Ideal of a Dwelling-House" in the following quotation from the writer's works:

"It was one of those delightfully irregular houses, where you go up and down steps out of one room into another, and where you come upon more rooms when you think you have seen all there are; and where there is a bountiful provision of little halls and passages; and where you find still older cottage rooms in unexpected places, with lattice windows and green growth passing through them. Mine was one of this kind, and had more corners than I ever counted afterwards; and a chimney (there was a wood fire on the hearth) paved all round with pure white tiles, in every one of which a bright miniature of the fire was blazing. Out of this room you passed into a little gallery, with which the other best rooms communicated, and so, by a little staircase of shallow steps, with quite a number of corner stairs in it considering its length, down into the hall. From this you came on a room which was part library, part sitting-room, part bedroom, and seemed, indeed, a comfortable compound of many rooms. Out of this you went straight, with a little interval of passage, into a plain room, with a small room adjoining; or you might, if you came out of another door (every room had at least two doors), go straight down to the hall again by half a dozen steps and a low archway, wondering how you got back there. Such, with its illuminated windows, softened here and there by shadows of curtains, shining out upon the starlight night; with its light, and warmth, and comfort; with its hospital jingle (at a distance) of preparations for dinner; and just enough wind to sound a low accompaniment to everything we heard, were our first impressions of the house."

Effect of Sugar on the Gastric Juice.

Sugar has been denounced by modern chemists as a substance, the effects of which on dyspeptics are deplorable. A writer in the *Medicin Practicien*, however, does not partake of these fears. He cites the case of a dyspeptic doctor, who, for twenty years, had a terror of sugar, but who now consumes three and three-fourths ounces of sugar daily, without inconvenience. Entering the field of experiment in this direction, he found that a dog ate eighty grains of sugar with two hundred of other food, and six hours afterwards its stomach showed but little food; the mucous lining of the stomach was red and highly conjested, and the congestion of the liver was notable. An animal opened after eating two hundred grains of food and no sugar, showed ninety to one hundred grains of food undigested. Sugar, then, favors the secretion of the gastric juice.

Tree Culture.

The National Forestry Congress, lately in session at Cincinnati, was the commencement of a general movement toward the reproduction of the woodland growth which is so rapidly disappearing from this country. While in France, England, Germany and other European countries, one of the principal bureaus of the government is that having charge of the forests and rivers, the whole matter is novel to us. In those countries the annual reports of the forestry bureaus are looked forward to as having an important bearing not only upon the sanitary condition and agricultural resources of the country, but upon the revenue as well. It was fortunate for the convention that it had the experience of those countries to aid it in the consideration of the important matters under discussion.

The combined effect of accidental fires, clearings, and the wasteful consumption of our forests in the production of lumber, railroad ties, tan bark, fuel, and for other purposes, with a total neglect of the means of reproduction, have depleted our resources to a greater extent than is generally recognized. The late convention was suggested by the national census statistics, which show that, should the destruction of the forests of the United States go on for the next quarter of a century at the same rate as during the last ten years, trees of a spontaneous growth will begin to disappear. To guard against this calamity by devising plans of forest culture, suggesting necessary protective legislation, and bringing the matter forcibly to the realization of the people, was the general purpose of the convention. During the three days of its session, papers were read by persons who have made forest culture a study upon the economic, æsthetic, scientific and hygienic aspects of tree-planting.

Ohio is going at this important work in a practical way. "Arbor day" is to be established—a day on which, all over the State, everybody will plant trees by the roadsides, in the public parks and on private property. Roadside planting associations are to be organized in all parts of the State, their purpose being to promote the planting of trees along the highways and in groves where suitable sites may be secured. The "arbor day" festival promises to become a feature of the Buckeye State which cannot be too soon adopted by every State in the Union.

Diastase in the White of Eggs.

It is well known that malt contains a substance capable of converting starch into sugar, to which the name of "diastase" has been given. A substance resembling diastase has been discovered in the albumen of the egg by F. Selmi, the original discoverer of ptomaines, or poisonous alkaloids, in dead bodies. Previous to his death, in August, 1881, he wrote the following letter to Ercolani: "Various considerations have induced me to assume that egg albumen contained a body that would change starch into sugar. In fact, I found that a filtered aqueous solution of albumen, when digested with a solution of soluble starch, induced this change very rapidly. This confirmed my suspicion, and I attempted to isolate this body from ordinary albumen. This I succeeded in doing by treating the albumen with three parts of water and precipitating the solution with a sufficient quantity of concentrated alcohol. The diastatic substance is in the soluble portion of it, as I was able to prove by experiments, by re-dissolving the albumen that had been precipitated, and making comparative experiments with that and with the substance that remained in solution after expelling the alcohol at a low temperature. The existence of a diastatic substance in egg albumen is of great physiological importance, which may be stated as follows: The albumen contains glucose, and the yolk of egg contains starch; the latter is changed into sugar when it reaches the albumen, and is thus converted into nourishment."

The Silver Iron Works.

We have received from Mr. Wm. J. Silver, of the Silver Iron Works, Salt Lake City, Utah, some very tasteful and attractive photographic specimens of their work. The specialties of this enterprising establishment are wrought and cast iron fences for house fronts, cemetery lots, etc., iron crestings for roofs, staircases and balustrades, and ornamental iron-work of every description. The photographic samples of this class of work include illustrations of two very elegant and artistic railings, one surrounding the grave of Brigham Young and the other surrounding the monument to Joseph Spalding.

The same establishment is likewise engaged in the manufacture of car wheel and axles of standard sizes; all wheels and axles, and other parts of the same size and track, are interchangeable.

Mr. Silver has been a constant reader of the Manufacturer and Builder from its start, which, we may be permitted to hope has contributed in a modest way to the building up of so creditable an establishment and to the development of such commendable enterprise.

Fair of the American Institute.

The managers of the fifty-first annual fair of the American Institute are making great preparations for the fall exhibition, which will open on the 27th day of September. Applications for space are daily made. It is expected that there will be an unusual number of machines in operation. The Babcock & Wilcox Co. are now putting in two of their new improved safety boilers, which are to furnish power for the machinery. In addition to the usual display of American manufactures, there will be a number of mechanical inventions in operation, including carpet and silk looms, and a complete filature showing the progress of the silk industry from the cocoon to the manufactured article. The building is to be lighted by the most approved electric light. Arbuckle's Ninth Regiment Band will perform every afternoon and evening.

The Tanite Company.

Some months ago the Tanite Company, of Stroudsburg, Pa., received an order from one of the foreign governments for a solid emery wheel 36 inches in diameter and 8 inches in thickness. A wheel of this size weighs about 800 pounds, and its list price is $500. A short time ago the company received a cable order from their Liverpool house for a special machine on which to run this immense wheel. They are now constructing this machine, which is the largest they have yet built. It is from an entirely new design, and will weigh when completed 2,200 pounds. When finished, illustrations of this machine will appear in some of the mechanical journals.

The company received recently an additional order from the same government for nearly $3,000 worth of solid emery wheels. Notwithstanding the recent enlargement of their works and increase of hands, they are kept busier than ever.

American Enterprise in Russia.

Some months since there was shipped to Russia, for the St. Petersburg water works, by the George F. Blake Manufacturing Co., of New York and Boston, two large pumping engines of the direct-acting, compound-condensing type, and of a capacity of nine million gallons per diem. We learn that the engines were transported, set up and put in operation inside of three months' time—two engineers accompanying the shipment and superintending the erection of the machinery. The engines are giving entire satisfaction to all concerned, and are creating considerable attention among Russian and German engineers, as they are the first large pumping engines of the kind that have been introduced on the continent. So much for American enterprise.

Miscellaneous and Advertising.

Under the head of "Fire-Escapes," one reported in the industrial statistics of the State of Pennsylvania, is: "Permission to jump out of the window."

The George Place Machinery Company, of 121 Chambers street, this city, have always on hand a large line of new and second-hand machinery of every description.

The Hancock Inspirator Company, whose head office and manufactory is at Boston, report sales of over 35,000 inspirators in the past four years. They employ 125 hands, and have a monthly product of 1,500.

"How to Keep Boilers Clean," and other valuable information for steam users and engineers. Book published by James F. Hotchkiss, 84 John street, New York. Mailed free to any address. (Mention this paper.)

The Valley Machine Co., of Easthampton, Mass., report orders on their books for steam pumps from California, Canada, Manitoba, Minnesota, New York, Ohio, South America, South Carolina, Pennsylvania and Texas.

Clem & Morse, of 413 Cherry street, Philadelphia, have all they can do to keep up with orders for their elevators and hoisting machinery. Owners of office and other buildings are finding out that the American public does not climb stairs as willingly as it once did, and the demand for elevating facilities grows steadily.

The success of the new Pulsometer steam pump, arranged with boiler on small boats built specially for the purpose of pumping out coal boats and barges, wrecking purposes, washing coal, putting out fires, filling boilers after cleaning, etc., by Messrs. Crowthers, Musgrave & Co., Eli Leonard & Son, O'Neal & Co., James McCleary and others, on the Monongahela river, has caused a demand for such boats. Messrs. Crowthers, Musgrave & Co. write that they can propel their boat four miles up stream and back in an hour, by having the new Pulsometer arranged to draw the water in at the bow and forcing it out at the stern. Messrs. Gray, Shook & Co., of 46 Water street, Pittsburgh, Pa., agents for the Pulsometer Steam Pump Co., have lately built several of these boats to meet the demand, one of which has been purchased by Mr. James Sweeny, of New Orleans, and sent South.

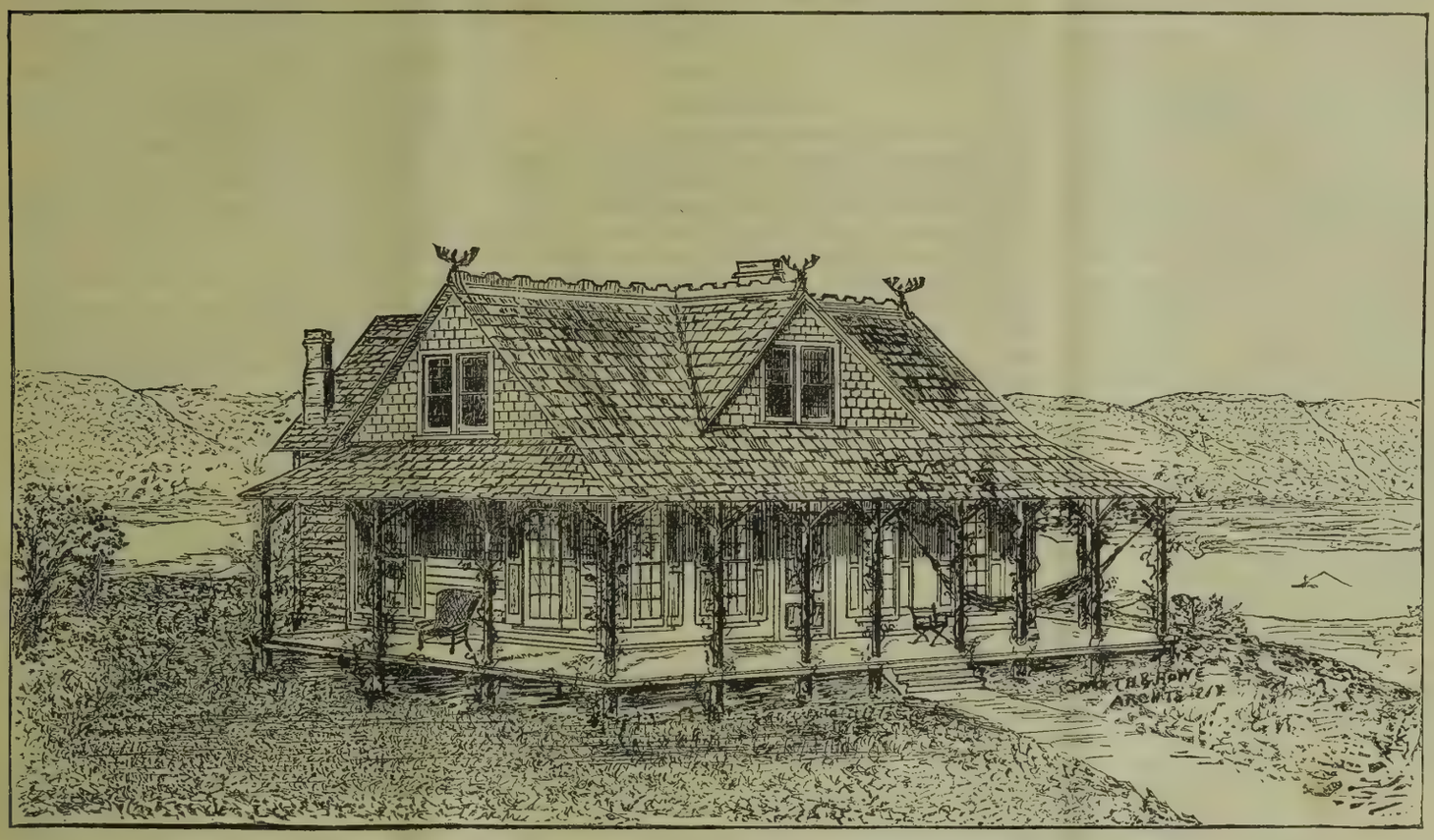
Design for a Hunting Box.

The hunting box shown in this number is being erected in the North Woods for the Hon. John Davidson, of Elizabeth, N. J., and seems well adapted to the purpose for which we understand it is intended—a rendezvous for a private party of hunters and fishermen.

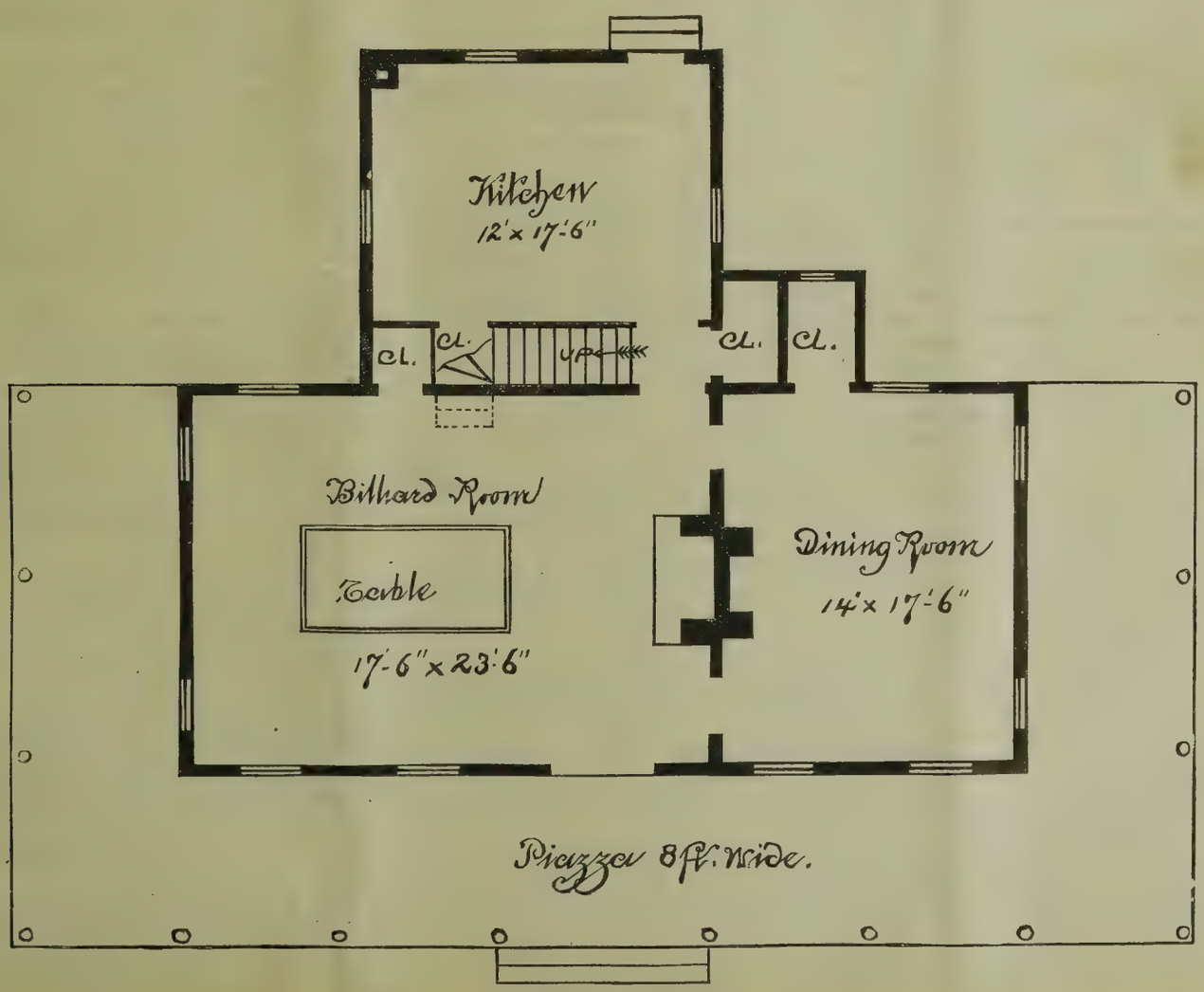
The broad, inviting piazza is likely to hear (or would, had it ears) many a marvelous story of big trout landed; while the billiard-room, with its large, open fire-place, is delightfully suggestive of cool evenings, log fires, and the pleasant clicking game. It is such a building as this that may suit some of the many clubs that year by year go off for a season of fishing or hunting and have no specially arranged club house.

The rooms in this house are of good size, there being, in addition to those here shown, three bedrooms upstairs. The material used is pine. The roof is shingled, and the piazza posts are of young trees stripped of the bark.

The site of this "box" is on the Salmon River, and the estimated cost about $1,500—a price that would doubtless be found to vary somewhat in different sections. The architects are Messrs. Smith & Howe, of 7 Warren street, New York.



DESIGN FOR A HUNTING BOX, COSTING $1,500.



GROUND PLAN.

The Statistics of Manufactures.

The results of the late census with respect to its industrial features, show some remarkable gains in production in some of our cities, and are instructive to all who are interested in the industrial progress of the country, however disappointing they may be to some whose local pride may be wounded. There have been many complaints of the imperfection of the methods employed in taking the industrial census of certain cities, especially in localities where the figures of production fall below what had been expected; but though there may be just cause of complaint in certain instances of this kind, we have no doubt that the published returns very fairly represent the actual condition of things. In any event, the figures will have to stand for the present decade as the most authoritative that we have in determining the relative importance of our several manufacturing centers.

The following tabulation, as approved by the Census Office, gives the number of manufacturing establishments in the leading industrial centers of the United States, the number of operatives employed, the amount of capital invested, and the value of the annual production of manufactured goods:

	Manufactories.	*No. of employees.*	*Capital.*	*Annual Product.*
Baltimore	3,596	55,201	$35,760,108	$75,621,388
Boston	3,521	56,813	42,750,134	123,366,137
Brooklyn	5,089	45,226	56,621,399	167,757,590
Buffalo	1,137	16,838	24,188,562	40,003,205
Chicago	3,479	77,601	64,177,335	241,045,607
Cincinnati	3,231	52,184	42,278,732	94,869,105
Cleveland	1,033	21,499	18,134,789	47,352,208
Detroit	875	15,062	14,202,159	28,308,580
Jersey City	555	10,688	11,329,915	59,581,141
Louisville	1,066	16,569	19,583,013	32,381,733
Milwaukee	821	19,620	13,811,405	38,955,133
Newark	1,299	29,232	23,919,115	66,234,525
New Orleans	906	9,439	8,401,390	18,241,000
New York	11,162	217,977	164,917,856	448,209,248
Philadelphia	8,377	173,862	170,495,191	304,591,725
Pittsburg	1,071	36,465	50,976,902	74,241,889
Providence	1,186	21,336	23,573,932	39,596,653
San Francisco	2,860	26,062	29,417,248	71,613,385
St. Louis	2,886	39,724	45,385,785	104,383,587
Washington	961	7,116	5,381,220	11,641,183

In comparing these figures with those of the previous census, the most striking features noticeable, are, that Philadelphia, which is generally supposed to be the leading manufacturing city of the Union, has taken the second rank in everything but the amount of capital invested, yielding her supremacy in these points to her neighbor New York, which latter city thus takes the leading place among American cities in respect to manufactures, that she has long held in commerce and trade. Another noticeable feature presented by the table, is the great advance made by Chicago in respect to her manufactures, having passed by Baltimore, Brooklyn and Cincinnati. In the amount of capital invested in manufactures, the number of operatives, and the annual value of her manufactured goods, Chicago now occupies a good third place, standing conspicuously ahead of the cities just named, and coming close in the rear of the two leading cities—New York and Philadelphia.

Don't Haul out the Fire.—What shall be done to prevent a boiler burning when short of water and with a heavy fire on the grate, is an important question. The first impulse on the part of many is to haul out the fire immediately; but the expediency of this course is questioned on the ground that probably it is the most dangerous plan that could be adopted. It is argued that whereas disturbing the fire causes intense heat for a short time, and at a point where heat is no further needed, throwing open the doors and extinguishing the fire with wet ashes obviates the first mentioned result, and is much the best course, instead of raking the fire over and adding to the danger to the boiler. The latter course gradually reduces, and never increases, the heat, and the pressure continues to fall.

Boiler Inspection.

The monthly report of the Hartford Steam Boiler Inspection and Insurance Co., for March last, shows the very gratifying fact that the number of boilers inspected was over 22 per cent greater than for the corresponding month last year. The number of visits of inspection made was 2,070; the total number of boilers examined was 4,642; while the number of complete internal inspections foots up 1,508. The hydrostatic test was applied in 326 cases. The number of boilers condemned was 50. Below is given an analysis of the defects found:

Nature of defects.	Whole number.	Dangerous.
Cases of deposit of sediment	231	44
Cases of incrustation and scale	362	38
Cases of internal grooving	14	5
Cases of internal corrosion	101	22
Cases of external corrosion	116	33
Broken and loose braces and stays	56	23
Settings defective	38	9
Furnaces out of shape	108	33
Fractured plates	164	89
Burned plates	100	38
Blistered plates	245	34
Defective Riveting	224	7
Defective heads	23	7
Leakage around tubes	227	23
Leakage at seams	105	27
Water gauges defective	45	20
Blow-out defective	14	4
Cases of deficiency of water	19	13
Safety valves overloaded	36	10
Safety valves defective in construct'n.	19	8
Pressure gauges defective	132	24
Boilers without pressure gauges	3	2
Total	2,382	513

New Publications.

Lake George. Illustrated. A Book of To-Day. By S. R. Stoddard. Glen Falls, N. Y.: Published by the Author. 1881.

Saratoga Springs. Its Hotels, Boarding-Houses and Health Institutions; its Mineral Waters, their Medicinal Properties; and suggestions as to Where, How and When to Drink them, and When not to Drink them; with various other matters of interest to the public. Same publisher. 1881.

The Adirondacks. Illustrated. Containing a Narrative of a Trip through the Wilderness, with a description of the Natural Features of the Region; Hints concerning Supplies and general Outfit for Camp and Trail; Cost and Manner of Reaching various Resorts; Hotels, with Capacity, Price of Board, etc.; Tables of Elevations and Distances; Maps, etc. Same publisher. 1881.

Map of Lake George. Same publisher.

Map of the Adirondacks. Same publisher.

The summer vacation season, which is now fairly upon us, makes a reference to the above publications relating to the most famous of Eastern summer resorts, very appropriate. The books relating to Lake George, the Adirondacks and Saratoga, are not mere dry compilations of facts and figures, with a little stereotyped narrative sandwiched in between, as is the case with the conventional guide-book, but are charming and interesting sketches of these famous localities, which one can read with pleasure. The maps are folded into convenient pocket-book form between stiff covers, and have been reproduced from the most reliable sources.

Work Manuals.—No. II. The Mechanics Slide-Rule, and How to Use it. Being a Compilation of Explanations, Rules and Instructions, suitable for Mechanics and others interested in the Industrial Arts, etc. Compiled and arranged by Fred. T. Hodgson.

No. III. Hints for Painters, Decorators, Paper-Hangers, etc. Prepared with special reference to the wants of Amateurs. By an Old Hand.

No. IV. Drawing Instruments. How to Use them, and how to take Care of them. By an Old Draughtsman. New York: The Industrial Publication Co. 1882. Price, 25 cents each.

These exceedingly practical and useful little books are the first of a series designed to cover the more prominent branches of the trades and handiwork, which are being issued in cheap form by the Industrial Publication Co. They all bear evidence of having been prepared by the hand of a competent master, and will be found to be reliable and valuable in the information they impart.

In No. II. rules are given for the measurement of all kinds of boards and planks, timber in the round or square, glazier's work and painting, brick-work, paver's work, tiling and slating, the measurement of vessels of various shapes, the wedge, inclined planes, wheels and axles, levers, the weighing and measurement of metals and all solid bodies, cylinders, cones, globes, octagon rules and formulas, the measurement of circles, and a comparison of French and English measures, with much other information that will be found useful by builders, carpenters, bricklayers, glaziers, machinists, and other mechanics.

No. III. gives a judicious selection of useful rules, data, methods and suggestions for house, ship and furniture painting, paper-hanging, gilding, color mixing, and other matters useful and instructive to painters and decorators.

No. IV. is a condensed treatise on the management, care and capabilities and applications of a box of instruments. It contains, besides, useful hints and suggestions on the management of drawing paper, drawing boards, T-squares, scales, variable curves, set-squares, colors and India ink. While designed for the information of architects, engineers and draughtsmen generally, it is intended particularly for beginners and non-professionals.

From an inspection of these three specimens, the series of "Work Manuals" promises to be a useful addition to the list of practical books. Their cheapness places them within the reach of all.

The Student's Guide in Quantitative Analysis. Intended as an Aid to the Study of Fresenius' System. By H. Carrington Bolton, Ph.D. New York: John Wiley & Sons. 1882.

This work is a collection of, and completion in book form, of a series of articles of great practical value, and highly appreciated at the time of their appearance, which were published in the *American Chemist*, and which were contributed by the author under the title "Schemes of Analyses Executed in the School of Mines, Columbia College." The methods given in Dr. Bolton's book are those which have been approved by Dr. Chandler. Many modifications of old methods which experiments have shown to be valuable and useful, appear throughout the work, most of which are to be credited to the author, Mr. Julien and Dr. Schweitzer, and a number of new methods have been introduced. The object of the author has been to aid the student in the use of the classic work of Fresenius, which in its arrangement is very perplexing to the beginner. In this the author, by the clearness of his descriptions and simplicity of arrangement, has succeeded very well.

Candle-Power of the Electric Light. By Paget Higgs, LL.D., etc. E. & F. N. Spon, New York, 44 Murray street; London, 16 Charing Cross. 1882.

The electric light is coming into general use for public lighting, and threatens soon to invade the place long exclusively occupied by coal gas for domestic lighting. Everything respecting it is a matter in which very general interest is felt, and no point in relation to it is of such direct importance, and bears so directly upon its future success, as that of its economy. On this point, too, there has been much written that is untrustworthy and misleading. On these accounts the above work, from the pen of an author well known as an investigator, and fully qualified to handle the subject understandingly, will be found very useful by all who desire to obtain trustworthy information on the subject.

The Christian Union. New York and Brooklyn Publishing Co., New York.

The *Christian Union* has been publishing recently a series of striking articles, entitled "How to Succeed." Among the contributors to these papers were Senator George F. Edmunds upon Success in Public Life; the Rev. John Hall, D.D., representing the Ministry; Dr. Willard Parker, Medicine; Thomas A. Edison, Mechanics; W. Hamilton Gibson, Art; General William Sooy Smith, Engineering; Commissioner George B. Loring, Agriculture; and Dr. Leopold Damrosch, Music. The series began in the *Christian Union* for April 13th, with a paper by Hon. Thomas F. Bayard on Success in Public Life.

OTHER PUBLICATIONS RECEIVED.

Socialism and Christianity. Sober Thoughts for all who are concerned in the Welfare of our Industry. By H. Cherouny, 17-27 Vandewater street, New York.

Scientific Proceedings of the Ohio Mechanics' Institute at Cincinnati. Published by the Institute.

Premium List of the Thirtieth Indiana State Fair, to be held at Indianapolis, September 25th to the 30th.

Statistics of the American and Foreign Iron Trades in 1881. Annual report of the Secretary of the American Iron and Steel Association, containing Statistics of the American Iron Trade to January 1st, 1882, and a Review of the present Condition of the Iron Industry in Foreign Countries. James M. Swank, Secretary. Presented to the Members June 15th, 1882. Philadelphia: The American Iron and Steel Association, No. 261 South Fourth street. 1882.

Proceedings of the Engineers' Club of Philadelphia. Edited by the Secretary, under the direction of the Committee on Publication. Published at the Rooms of the Club, No. 1523 Chestnut street, Philadelphia, March, 1882.

Seventh and Eighth Annual Reports of the Secretary of the State Board of Health of the State of Michigan. Lansing: State Print. 1880-1881. From the Board.

Annual Report of the Regents of the Smithsonian Institution, for the Year 1880. Washington: Government Print. 1881. From the Secretary.

Geological Survey of New Jersey. Annual Report of the State Geologist for the Year 1881. Trenton: State Print. 1881. From Prof. Geo. H. Cook.

First Annual Report of the Bureau of Ethnology to the Secretary of the Smithsonian Institution, 1879-1880. By J. W. Powell, Director. 4to, pp. 603, numerous colored plates. Washington: Government Print. 1881. From Hon. Chas. O'Neill, M. C.

Reissued Patents. A Warning to Inventors. By H. Howson, Sr. Philadelphia: T. & J. W. Johnson & Co. From the author.

This department is intended to furnish, for the benefit of all our readers, information on any subject of a scientific or technical character falling within the field of THE MANUFACTURER AND BUILDER. *Any of our readers possessing additional or more correct information than that which we give relating to the questions, are cordially invited to communicate it to us for publication. We also request that all questions or answers be written on separate pieces of paper, and addressed to the Editor.*

QUESTIONS.

(3044) QUALITY OF HYDRAULIC CEMENT.—Will you please indicate in your next answers to correspondents, some of the distinguishing qualities of good hydraulic cements, that would be a sort of guide in buying and using them.—L. M. B., Byrooklyn, N. Y.

(3045) THE PERFECT STEAM ENGINE.—What amount of power ought we to obtain with a steam boiler and engine without loss or waste of any kind?—B. P. W., Willimansett, Mass.

(3046) BENZOLE AND BENZINE.—What is the difference between benzole and benzine? or are these not two names for the same substance?—T. W. L., Rochester, N. Y.

(3047) TO GALVANIZE CHAINS AND CASTINGS.—Please give the process used by manufacturers to galvanize chains and castings.—A. T. R., Wakeman, O.

(3048) TO JAPAN CASTINGS.—How are castings japanned?—A. T. R., Wakeman, O.

(3049) LINING IRON WITH PORCELAIN.—What is the process of lining iron vessels with porcelain?—A. T. R., Wakeman, Ohio.

(3050) PREPARING RUBBER FOR MOLDING.—How is rubber prepared for running or casting in molds?—A. T. R., Wakeman, O.

(3051) LATE HOURS FOR WORK.—Do you consider study at late hours at night, say to 2 o'clock in the morning, to be injurious?—A. Y., Conshohocken, Pa.

(3052) QUALIFICATIONS OF CANDIDATES FOR CADET ENGINEERS.—Will you please inform me in what studies an applicant is examined to receive an appointment as a cadet engineer. To whom should I write for particulars of examination, etc.?—A. B. D., Tonawanda, N. Y.

(3053) CHEMICAL TEST FOR THE DIAMOND.—I would like to know of a simple chemical test that I could use to determine the genuineness of diamonds, that would not in any way injure the real stone.—H. E. H., Logansport, Ind.

(3054) GLAZED OR ENAMELED BRICKS.—I have read lately an account of the famous porcelain towers of China, and would like to know if it is not most probable that the structures were made of glazed terra-cotta or bricks?—J. McC., Jamestown, Va.

(3055) FINE GLOSS ON SHIRTS AND COLLARS.—Please give the manner in which shirts and collars are made glossy and stiff in ironing.—E., New York City.

(3056) ALUMINUM BRONZES.—I lately saw, in your paper, I think, an article highly commending aluminum bronze for journals. Can you inform me where the metal is manufactured?—S. R., San Francisco, Cal.

(3057) MAKING PAPER TEMPORARILY TRANSPARENT.—Is there any ready method of making paper transparent, so that it may be used for tracing or drawing, and then when finished, to return to its original opacity? If there is, I should be glad to know of it through your columns of "Notes and Queries."—J. C., Keokuk, Iowa.

(3058) PATENT SCREW-DRIVER.—I would like to know where I could find a patent screw-driver. I do not mean a ratchet screw-driver. I have reference to one made like a drill—when you bear down on the handle, it turns the screw around. When you bear down on the handle, the screw-driver slides up into the handle. That part of the screw-driver that slides into the handle is made like a drill. Where are they made, and how can I obtain one? They are not in this market.—F. M. B., Glenwood, Iowa.

(3059) WATER-PROOFING CANVAS.—Please give a reader of your valuable journal a receipt for making canvas water-proof.—G. W. J., Chicago, Ill.

(3060) TO FIX PENCIL MARKS.—How can I fix pencil drawings so that they will be permanent, like India ink drawings?—J. E. H., Hartford, Conn.

REPLIES.

(3044) QUALITY OF HYDRAULIC CEMENT.—On this subject, as on most others with which the engineer and constructor have to deal, Trautwine gives sound advice, and from his latest "Pocket-Book" we abstract freely the following points bearing on the question. Color is no indication of strength in hydraulic cements. The finer they are ground the better. At least 90 per cent should pass through a sieve of 50 meshes per lineal inch of wire No. 35 American wire gauge (.0056 inch thick), or 2,500 meshes per square inch. Weight is a good indication when equally well burned. A flat cake of good cement paste placed in water as soon as it admits of doing so safely, and left in it for a week, should show no cracks. New cement is not as good as when a few weeks old. The term "setting" does not imply that the cement has hardened to any great extent, but merely that it has ceased to be pasty and has become brittle. Quick-setting cements may do this sufficiently to allow small experimental samples to be lifted and handled carefully within 5 to 30 minutes; while others may require from 1 to 8 hours. Slow setting does not indicate inferiority, for many of the very best cements are the slowest setting. A layer of very quick-setting cement may partially set, especially in warm weather, before the masonry is properly lowered and adjusted upon it, and any disturbance after setting has commenced is prejudicial. Such cements are to be regarded with suspicion, and subjected to longer tests than slow-setting ones. Still, quick-setting cements are best in certain cases, as when exposed to running water, etc. They may be rendered slower by adding a bulk of lime paste equal to 5 to 15 per cent of the cement paste, without weakening them seriously. As a general rule, cements set and harden better in water than in air, especially in warm weather. If, however, the temperature for the first few days does not exceed 55° to 65° Fah., there seems to be no appreciable difference in this respect; but in warm air cement *dries* instead of *setting*, and thus loses most of its strength. In hot weather every precaution should be taken to guard against this. The time required to attain the greatest hardness, is many years; but after about a year, the increase is very small and slow, especially with neat cement. Moreover, any subsequent increase is a matter of little importance, because generally by that time, and often much sooner, the work is completed and exposed to its maximum strains. Sand retards setting and weakens the cement paste. But although with sand the strength of the mortar may never attain to that of the neat paste, yet it increases with age in a greater proportion, so that a neat paste, which, at the end of a year, would be but twice as strong as at the end of 7 days, may with sand yield a mortar which at the end of a year would be three, four or five times as strong as at the end of 7 days. Good Portlands at the end of a year usually have from one and a half to twice their strength at 7 days; and the American natural cements, Rosendale, Louisville, Cumberland, etc., from two and a half to three and a half times; but inasmuch as Portlands average, roughly, about five to six times the strength of the others in 7 days, they still average about two and a half to three times as strong in a year or longer. Again, cements of the same class differ much in the rapidity of their hardening, owing to differences in composition or care in manufacture, so that one may be much stronger at the end of a month than another; hence tests for a week or a month are not entirely conclusive of their actual value. There seems to be, according to this author, a period, occurring from a few weeks to several months after having been laid, at which a cement and its mortars for a short time not only cease from hardening, but actually lose strength. Then after a while they recover, and go on hardening as before. Some experimenters think this opinion has originated in some oversight, but Trautwine is inclined to believe it to be a fact. The above facts and conclusions, drawn from eminently trustworthy and careful authority, we believe will convey to this inquirer the kind of practical information he is seeking.

(3045) THE PERFECT STEAM ENGINE.—To obtain the possible mechanical duty of the theoretically perfect steam engine, we must know first the absolute heating value of pure coal (carbon). This factor has been carefully calculated by several eminent experimenters, who have determined that if the entire quantity of heat given out in the combustion of one pound of pure carbon, could be directly transmitted without loss to water, it would be sufficient to raise the temperature of one pound of water 7,900° of the Centigrade scale. Having this element at hand, it is now easy to calculate the possible duty of the perfect steam motor. We need only determine the mechanical equivalent of the thermal value of a pound of pure coal, to learn the possible duty of the steam engine. This is found by multiplying the thermal equivalent of coal by the figures representing the mechanical equivalent of heat—namely, $7{,}900 \times 1{,}390 = 10{,}980{,}000$. This result represents foot-pounds. To convert these figures into horse-power, which is a more familiar expression, we divide them by 33,000; and we shall have as the result that one pound of pure coal burned in one minute in the perfect boiler, and utilized without loss in the perfect engine, should yield us in the form of work, $\frac{10{,}980{,}00}{33{,}000} = 332$ horse-power during one minute; or, if burned during one hour, then one-60th of 332, or 5½ horse-power per hour. This is what the theoretically perfect steam engine should yield. In actual practice, the average steam engine (using the term to indicate the entire mechanism) requires from 3 to 4 pounds of coal to develop a horse-power; and the best forms of engine representing the most approved construction, require from 2 to 2½ pounds of coal per horse-power, showing that in reality we have as yet only been able to realize about 15 to 20 per cent of the theoretical value of our fuel. The chief elements of loss are imperfect combustion, imperfect utilization of heated gases, radiation and conduction of heat to surrounding objects, and friction. By the use of steam of much higher pressures than is it present the custom, and by the further development of the use of steam expansively, there is no doubt that our engineers will in time approach much more closely to what theory shows to be possible, than they have thus far succeeded in doing.

(3046) BENZOLE AND BENZINE.—Faraday, in 1825, discovered a peculiar liquid which he obtained by condensation from ordinary coal gas. The same substance was subsequently discovered by the German chemist Mitscherlich, of Berlin, who obtained it from benzoic acid (found in gum benzoin and other gums). Mitscherlich proposed for the substance the name of benzine. Faraday objected to the name as being too similar in termination to the distinctive names already chosen for the alkaloids (strychnine, morphine, etc.), and proposed for it the name benzole, which by general acceptance is now nearly universally applied to it. The name benzine is applied universally in the United States, though less generally in other countries, to one of the light products obtained from the distillation of petroleum. It corresponds to what is still called very generally in England "petroleum spirit," and is a very different substance from the above named benzole obtained from coal tar and from benzoic acid. Benzole has a specific gravity of .85, corresponding to 35° Beaumé, freezes at 37° Fah., readily dissolves sulphur, phosphorus, caoutchouc, asphaltum, wax and fatty bodies; is volatile at all temperatures, but not so much so as benzine. Its vapor is inflammable, and it plays an important role with its homologues in contributing to the luminosity of our common burning gas. By treatment with fuming nitric acid, benzole is converted into nitro-benzole, a compound that is of great interest from the fact that it plays an important part in the manufacture of aniline from the benzole of coal tar. Benzine, on the other hand, is not a simple substance, but is the commercial name by which those portions of the products resulting from the distillation of petroleum are designated which have a gravity of from 80° to 63° B. (average 70° B.) It cannot be frozen, volatilizes at all temperatures, giving off a vapor that is dangerously inflammable. It is not nearly so good a solvent of asphaltum or pitch as benzole, and cannot be converted into nitro-benzole, consequently is useless for the preparation of the aniline colors. It is largely employed in the arts for making varnishes, paints, etc.; for dissolving fats and oils from animal and vegetable matter; for removing grease stains from cloth, etc. The French still adhere to the Mitscherlich name benzine, to distinguish benzole, and this fact often causes confusion, especially in the translation of chemical articles from that language into English, or *vice versa*, when the translator is not familiar with the fact above named. Benzole and benzine, as we have shown, are therefore entirely different substances.

(3047) TO GALVANIZE CHAINS AND CASTINGS.—The first requisite of a plant for galvanizing purposes is a vessel or pot, as it is technically called, in which the zinc is melted, and in which the objects to be galvanized are immersed. This vessel must be of sufficient size to accommodate the largest castings that will be required to be worked, and may be for miscellaneous jobbing and small castings a hemispherical pot of cast iron from 3 to 5 feet in diameter. If larger work is to be done, the pot should be rectangular, from 10 to 15 feet long, 18 inches to 2 feet wide, and about 3½ to 4 feet deep. The circular pot can be fired from the bottom, and simply set it brick-work with the furnace below. The rectangular pot should be set with its bottom on a solid foundation, and should be built up flush to the top with brick-work, leaving a space of about 8 to 10 inches all around for firing, and providing draft openings at the sides at different hights to regulate the fire. The zinc used for the purpose should be the best. It should be kept at a temperature of about 1,000°, and as nearly as possible maintained at this temperature while working, as much of the success of the operation will depend on the attention given to this point. The objects to be galvanized require first to be thoroughly freed from oxide, so as to present a clean metallic surface to the zinc. This is usually effected by immersing them first in a bath of very dilute sulphuric acid, where they must remain for some time until the scale is thoroughly cleaned off; from this they are taken, washed off in water, and then immersed for a short time in a bath of muriatic acid of usual commercial strength. The last acid bath effectually takes off what little remnant of scale that may remain, and the film of the muriatic acid that remains on the iron when taken out effectually checks any tendency to oxidation,

which would be found to take place if the articles were dried at once from the sulphuric acid bath. From the muriatic acid bath, after an immersion of a few minutes, the goods are removed, allowed to drain, and placed in a drying oven, or hot-air chamber of any convenient construction and size, and when completely dry, which may take from one quarter of an hour or longer, according to circumstances, they are ready for dipping. The goods, on coming out from the drying room, should show a grayish color with an abundance of whitish spots (of chloride of iron) over their surface. Small objects are dipped into the melted zinc (a large number together) in perforated ladles, raised to the surface from time to time, and moved about by the operator until they appear to be entirely coated; then they are vigorously thrown up and down in the ladle to remove the excess of zinc which adheres to them, which finds its way out and into the bath through the perforations of the ladle, and the contents of the ladle then emptied into a vessel of water. During the operation of coating with zinc, sal-ammoniac must be freely thrown upon the articles to insure a clean and uniform coating of zinc, as this substance is an excellent flux. Larger objects are either dipped into the zinc on hooks or tongs, and handled on these until properly covered; or, when still larger, are placed in the zinc and left to themselves until finished. The length of time required will vary, according to the purity of the iron and the size of the articles. Large castings usually require from fifteen minutes to half an hour, and small articles from five to ten minutes. With many small castings, especially such as have been well cleaned of sand and scale by rumbling, as most small wrought iron articles, it will be unnecessary to do more than give them a short immersion in the muriatic acid to get them clean enough for zincing. Chains are galvanized in precisely the same way, and only require, on being withdrawn from the zinc, to be thoroughly shaken or beaten to remove the superfluous metal between the links.

(3048) To Japan Castings.—Metallic objects require no other preparation for japanning than cleaning with turpentine to get rid of grease or oil. They require no priming coat, the japan ground being laid on immediately. Spon gives the following directions: The proper japan grounds are either such as are formed by the varnish and color, where the whole is to remain of one simple color, or by the varnish with or without color, on which some painting or other decoration is to be laid. This ground is best formed of shellac varnish and the color desired. Any pigments whatever may be used with the shellac varnish, which will give the tint of the ground, and they may be mixed together to form any compound colors; and particular modes are adopted to give particular degrees of brightness in certain cases. They should all be ground very smooth in spirits of turpentine, and then mixed with the varnish. It should be spread over the work very carefully and evenly with a camel-hair brush. Metals never require the priming coat which is used for wood; the japan ground may be applied at once to them without any other preparation than cleaning. Metals should receive from three to five coats, and between each must be dried in an oven heated from 250° to 300° Fah. The following is a formula for black japan grounds from the same authority: Mix shellac varnish with either ivory black or lampblack, but the former is preferable. This may be always laid on with the shellac varnish, and have its upper or polishing coat of common seed lac varnish.

(3049) Lining Iron with Porcelain.—The white enamel for hollow ware is made of powdered flints, ground with calcined borax, fine clay and a little feldspar. This mixture is made into a paste with water, and brushed over the pots after they have been thoroughly scoured with dilute sulphuric acid and rinsed clean with water. While still moist, they are dusted over with a glaze composed of a mixture of pulverized feldspar, carbonate of sodium (dry), calcined borax and a little oxide of tin. Thus prepared, the pots are gradually dried, and then the glaze is fired or fused under a muffle at a bright red heat. Some oxide of lead is occasionally added to the above mixture, but though it increases the fusibility of the glaze, it impairs its value, since it will not resist the action of acids in cooking.

(3050) Preparing Rubber for Molding.—The operations of preparing and molding rubber are so exceedingly numerous, and would require such elaborate and detailed description, that we cannot find space for it in this department. We may be able at some time in the near future to prepare and publish an illustrated description of the processes employed. We can do no more at present than refer this inquirer to the several encyclopædias of the arts and manufactures—Ure's or Spon's—which he may consult at any public library for the information he seeks.

(3051) Late Hours for Work.—This is a question on which much diversity of opinion prevails. Many persons, especially students and literary men, contract the habit of working until far into the morning, and keep it up for years, without apparent detriment to the physical or mental forces. One reason for this, and probably the principal one, lies in the fact that the quietness which falls upon everything late at night allows mental work to be carried on without the distractions which are necessarily incident to the noise and bustle of daytime. It is doubtful, however, if the feeling which prompts many brain workers to put off their tasks until late at night is not a delusive one. The quietude of late hours is indeed conducive to mental concentration; but after the mind and body have been awake and active during the long hours of the day, it is to be questioned if the mind is in condition to develop its best efforts. It appears to us, on rational grounds, that the early morning should be the best time for study. Then both mind and body have been refreshed and invigorated by sleep, and have all their freshness and vigor. We believe, on general principles, that if the habit of early morning study were cultivated, it would prove far more healthful than the very common habit of late study. When one is blessed with a vigorous physique, the "burning of the midnight oil" may be persisted in for years without any apparent bad results, but it stands to reason that unusual and prolonged mental work after body and mind are both jaded, cannot be persisted in without injury. The editor must confess, however, that he does not practice what he preaches. The breaking of habits once formed is difficult, and this is probably the reason why he, in common with so many others of similar avocation, persists in doing most of his editorial work late at night. Personally we have never tried to acquire the old-fashioned habit of "early to bed and early to rise," though satisfied that it is conducive to health.

(3052) Qualifications of Candidates for Cadet Engineers.—We state for the information of this inquirer, respecting the qualifications of candidates applying for appointments as cadet engineers in the United States navy, that application may be made by candidates or their friends to the Secretary of the Navy, stating age, date of birth, educational advantages, and satisfactory evidence of health and good moral character, which application is placed on register; but neither the registration of names nor priority of application gives any assurance of appointment. Applicants must be not under sixteen or over twenty years of age, and not less than five feet high. The number of appointments is limited by law to twenty-five annually. Those whose applications have been favorably received, will be advised of the fact, and will receive notification to appear early in the month of September at the Naval Academy for examination. Candidates must be physically sound, well formed and of robust constitution; and those who possess the greatest skill and experience in the practical knowledge of machinery (other qualifications being equal) will have precedence for admission. The Board of Examiners have the power of exercising discretion in the above requirements to each individual case, rejecting no candidate who is likely to be efficient in the service and admitting no one who is likely to prove physically inefficient. Candidates once rejected by the Board of Examiners are not allowed a re-examination. Candidates will be required to pass a satisfactory examination in the following branches: English grammar, arithmetic, elementary geometry and trigonometry, geography and elementary natural philosophy. The above information will be useful to this inquirer in indicating generally the qualifications of candidates for appointments as cadet engineers. For specific and detailed information, we refer him to the Secretary of the Navy, Washington, D. C. If he will address a letter as above, making the same request he has made of us, he will receive in reply a printed form conveying all the information he requires, much of which our space will not permit us to give.

(3053) Chemical Test for the Diamond.—The test named below will answer the purpose of this inquirer very well, we think, as it will infallibly distinguish the real stone from the imitation, and in nowise injure the real stone. It is as follows: Take a leaden vessel of saucer shape and moderate size, in which place some powdered fluorspar, which cover with enough oil of vitriol to completely moisten the powder. Then put in the stone to be tested, and gently warm the mixture over a gas lamp or any other convenient source of heat. This should be done in a good draft where the vapors will be drawn up a chimney or dissipated, as they are dangerous to breathe. When the evolution of vapors appears to have ceased, which will occur in from five minutes to a quarter of an hour, according to the quantity of material employed, the heat should be withdrawn and the vessel allowed to cool. The stone may now be fished out from the pasty mass and examined. If it shows no signs of being attacked, you may be assured that it is a genuine stone. A paste stone will be found to be strongly corroded by the hydrofluoric acid that has come in contact with it; and if a small one, will probably be searched for in vain, having been entirely dissolved. The test is infallible, but is open to this one objection—namely, that really valuable stones, like the topaz for example, that may perhaps be palmed off as diamonds, may in this way be seriously injured.

(3054) Glazed or Enameled Bricks.—We have little information respecting the interior of China and its cities, structures, etc., that can be relied on, and many of the wonderful stories of earliers writers, who drew heavily on their imaginations for their facts, have been repeated by later writers without investigation, until they have come to be looked upon as facts, although originally purely fictitious or grossly exaggerated. With respect to the so-called porcelain towers, it is safe to class them in the last named category. They are without question, what our inquirer suspects them to be—namely, structures erected of glazed or enameled bricks, the exposed surface of which resembles porcelain, both in its appearance and in its ability to withstand atmospheric influences, whence the origin of the fiction which represents them to be constructed entirely of porcelain. Within the past few years, a Pittsburgh inventor, after many experiments, succeeded in devising a process for giving to bricks a smooth, hard, enameled coating, which will not "craze" or crack, and which forms an exceedingly durable and elegant surface. These enameled bricks are produced in many colors, and have come into extensive use in the Eastern cities of the United States.

(3055) Fine Gloss on Shirts and Collars.—For the information of this correspondent, we repeat our answer to the same question (see Query 2669, August, 1880). We do not believe that the secret of imparting a high gloss to linen lies in the use of any particular substance. Gum arabic, white wax, paraffine, spermaceti, and other things of that nature, have been suggested for the purpose, and no doubt are used to a greater or less extent; but the real secret of success in artistic laundry work, we believe, lies in the character of the iron used for the purpose and the skill with which it is handled. A heavy, self-heating iron is generally used by professionals. The iron should be hard, heavy and highly polished, and should be rounded at the point, to permit of great pressure being brought to bear on a small space of the article, instead of being spread over the whole space of the iron. Any of the above mentioned additions to the starch will improve the quality of the work, but the character of the iron and its shape and weight, and dexterity in its use, are the prime essentials of success. We have no further suggestions to add to the above.

(3056) Aluminum Bronzes.—We do not think that aluminum bronzes are made in this country. While all who have investigated the subject agree in praising these alloys very highly, their comparatively high price has, most probably, debarred them from general introduction. Aluminum, in spite of the efforts of some of the most noted chemists of the world, still defies cheap production, and commands about the price of silver. This fact is most unfortunate, for the metal and its alloys would undoubtedly find a very extensive introduction in the arts if once this hindrance were removed. A great field of utility awaits it, for undoubtedly the problem will ultimately be solved. We doubt if the aluminum bronzes can be obtained save by special order from the French and German works where the metal is manufactured, and such an order would have to be given through some one of the importing houses. Since our previous communications on this subject, we have learned to our regret that the effort to establish the manufacture of this metal, by a new process, in Philadelphia, has proved a failure. This we regret the more since at the time the process was first brought to our notice, it appeared to be a very promising one. Unfortunately it proved to be this and nothing more. Still we do not despair of seeing the problem of the cheap manufacture of this remarkable metal solved satisfactorily and practically at no distant day.

(3057) Making Paper Temporarily Transparent.—There are several methods that will serve this inquirer's purpose. By coating a sheet of paper with benzine, it becomes translucent until the oil evaporates, when it need only be retouched with more oil to become again translucent. The benzine evaporates quickly, but has the objection that the paper retains a perceptible odor of the oil for a long time. Another, and perhaps better, method is to make a solution of one part of castor oil in two or three of absolute alcohol, and coat the paper with this. The alcohol soon evaporates, and the oil left behind keeps the paper transparent. When the drawing is finished, the oil can be washed out by dipping the paper repeatedly in alcohol.

(3058) Patent Screw-Driver.—We have made diligent inquiry, but cannot learn that any tool of the kind described by this inquirer is in the market. From what we glean of the tool as he describes it, we do not think it would work. If any of our readers know of any such tool, we would be pleased to hear from them.

(3059) Water-Proofing Canvas.—The best receipt for water-proofing canvas, and woven fabrics generally, that we know of, is the following: The material should be taken successively through baths of sulphate of alumina, and of soap and water. The common sulphate of alumina of commerce (called concentrated alum cake) answers very well for the first bath. It readily dissolves in cold water, to the extent of 1 part in 10 parts of water. The three baths, of alumina salt, soap, and water, should be arranged side by side, so that the canvas may be passed from one to the other. The soap bath should be kept hot, and some arrangement should be devised to keep the stuff down in the bath while being passed through. The fabric should be thoroughly soaked in the alumina bath. The theory of the operation depends on the formation of an insoluble alumina soap which adheres to the fiber of the fabric, and which is water-repellant. The goods so treated are left quite pervious to air, but will resist water.

(3060) To Fix Pencil Marks.—To render pencil drawings or writing as permanent as India ink is impossible, from the superficial nature of the markings made with the pencil. They may, however, be made so permanent that they will not rub out, by simply washing the pencil marks with well skimmed milk that has been diluted with an equal bulk of water. Apply the liquid to the markings with a soft camel-hair brush, and avoid rubbing. When gone over, place on a flat board to dry.

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Improved Machinists' Tools.

The machine illustrated in Fig. 1 is intended for any variety of heavy milling, being of a rigid and heavy pattern, with a positive geared motion for the spindle, which is fitted to bronze boxes having adjustments to compensate for wear. It is thoroughly built in every respect, and is so proportioned as to allow an ample resistance in the different parts to the strains to which they may be subjected. Feeding is accomplished automatically, with the knee bracket and carriage in any position, as connection with the power is made through a universal joint. The feed is stopped at any point by means of an adjustable trip, which acts with the table moving either way. An adjustment of 5 inches to and from the face of the column can be obtained with the carriage, and also a vertical adjustment of 11 inches for the knee bracket, the highest point for the top of the table being one inch below the center of the spindle. To the head is screwed a heavy arm for the support of an out-board center, which is free to slide upon the arm, and is bound in any desired position by tightening a single screw. In this sliding yoke is also a screw adjustment for the center itself. The base of this machine is hollow and provided with shelves, making a cupboard for the reception of tools, accessible through a door on one side of the column.

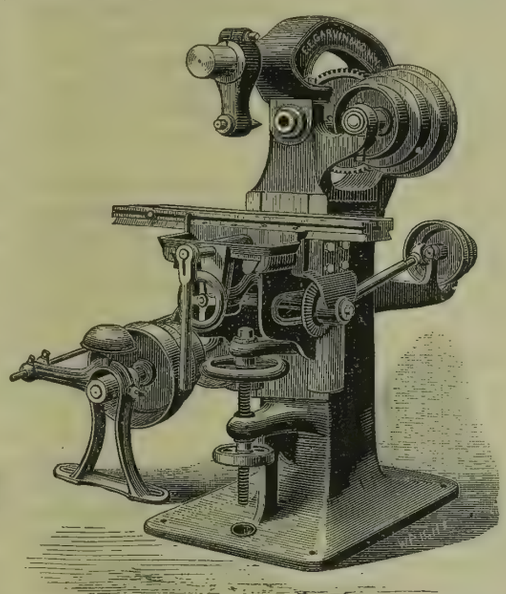

Fig. 1.—Improved Back-Geared Milling Machine.

The machine weighs, when ready for shipping, 1,300 pounds.

Fig. 2 represents a 15 inch hand lathe, and is a recent design of the manufacturers. The general appearance of this machine discloses the aim of the makers—to produce a lathe which shall be rigid, smooth running, durable, and easily handled. The front box is cast iron, lined and plugged with babbitt metal; the rear box is composition. Both boxes have all necessary adjustments for wear. As the boxes are fitted up round, it is a very simple matter to replace those, which, by long use, have become worn, or by any accident have been injured. The spindles are of steel, and the head spindle is hollow, with an $^{11}/_{16}$-inch hole its entire length. The front bearing has a double taper, the large end of which is $1^{15}/_{16}$ inches diameter. The cone is of large diameter, with a face for a 2¼-inch belt, turned inside and outside to insure a perfect balance. The actual swing of the lathe is 15½ inches, and upon a 5-foot bed a length of 39 inches can be taken between the centers. The tail stock and T-rest are secured to the bed by means of cam binders, operated by levers, which are within convenient reach from the front of the lathe. These levers, when raised to loosen the binders, are caught and held up by spring clamps, keeping the binders away from the bed until the levers are forced down in the act of binding. The binder bolts are closely fitted, so there is no drag in sliding the tail stock or rest along the bed. The tight and loose pulleys on the counter-shaft are 8×3 inches, running 185 revolutions per minute. The weight of this lathe, when ready for shipping, is 575 pounds.

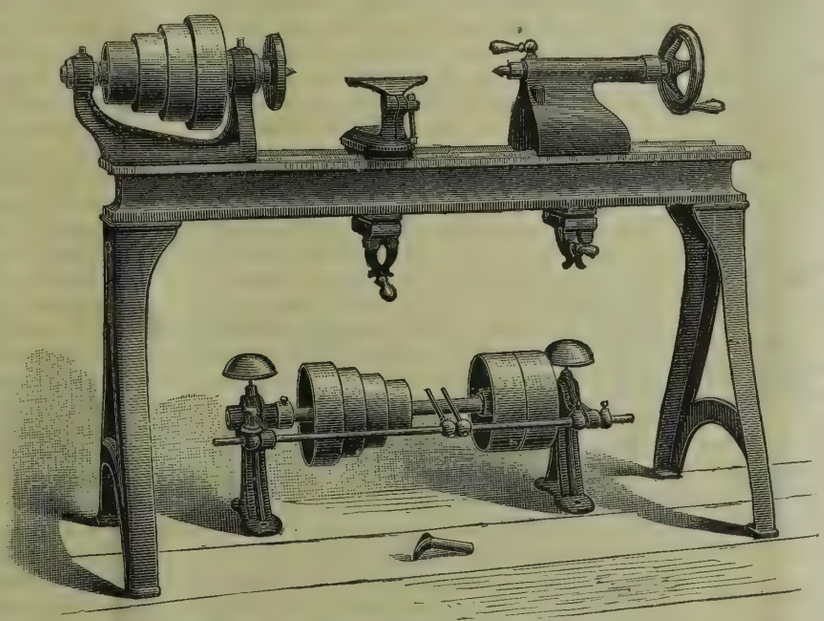

Fig. 2.—Improved 15-Inch Hand Lathe.

The above described machines are manufactured by E. E. Garvin & Co., of 139–143 Center street, New York, from whom further details may be obtained.

ANOTHER ALPINE TUNNEL UNDER MONT BLANC.—The project for constructing a third railway tunnel beneath the Alps under Mont Blanc already meets with considerable opposition, particularly on scientific grounds. Herr Heim, a Swiss savant, of the Polytechnicum of Zurich, contends that the piercing of Mont Blanc would be a work of immense difficulty. In one part the tunnel would have to be cut through a formation of anhydrous gypsum, which swells on exposure to the air, and is almost impossible to stay. Moreover, the temperature of the galleries, judging from the experience of the St. Gothard tunnel, would be from a minimum of 86° Fah. to a maximum of 122°.

Competition between Gas and Electricity.

The cost of electricity is near enough to that of gas to enable it to offer a very substantial competition, and one which may be expected to grow stronger with increased experience and future improvements. That under the stimulus of this competition considerable improvement will be made in lighting by gas seems very probable. Already it has been shown that in the matter of burners there is a wide field for invention, and that the results now usually obtained are much under what are possible. With the high-power burners of Siemens, the illumination obtained from 16-candle gas has been more than doubled, and in others it has been carried up to from 5 to 5½ candles per foot. How suitable burners yielding such a great increase of light will be for the general purposes of lighting, and whether they can with advantage displace the simple flat tip, remains to be seen; but the present indications are that it is chiefly through the use of improved burners that gas must endeavor to resist the assaults of the incandescent light. Competition on the basis of a gas of higher illuminating power simply, without a resort to improved burners, does not seem very promising. The recently published report of the sub-commission appointed to test the incandescent lamps at the Paris Exhibition, of which Mr. Crookes was a member, shows that a 32-candle lamp can be maintained with an increase of from 28 to 37 per cent of the power required to sustain one of 16 candles, while with gas such an increase of illumination will require an additional expense of fully 50 per cent of the cost of one of the lower candle-power. This is so with the Lowe gas, with which 3 gallons of oil are sufficient to give 16 candles; but 6 are required for 32, and it is not probable that coal gas can be enriched any cheaper. Whether the limit to progress in gas lighting—both in the matter of improvement of manufacture and burners—is sufficiently far off to give gas unquestioned possession of the field of lighting or not, the result can alone determine. But if the figures presented can be at all relied upon, they show that gas manufacturers, and those interested in gas property,

will do well not to underrate the strength in their own domain of this rising industrial power.

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Agencies where the Manufacturer and Builder can be Found on Sale.

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New England News Company, Boston, Mass.
Central News Company, Philadelphia, Pa.
Western News Company, Chicago, Ill.
St. Louis Book and News Co., St. Louis, Mo.
Cincinnati News Co., Cincinnati, Ohio.
Detroit News Co., Detroit, Mich.
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Newark News Co., Newark, N. J.
Northern News Co., Troy, N. Y.
Albany News Co., Albany, N. Y.
Toronto News Co., Toronto, Ontario, Canada.
Toronto News Co., Clifton, Ontario, Canada.

Special Edition of October Number.

In accordance with our annual fall custom, we shall publish a Special Edition of 10,000 copies of the October number of the MANUFACTURER AND BUILDER, in addition to our regular issue, for general circulation. It is our intention to distribute these extra copies gratuitously among the wood and iron manufacturers of the country, and to builders, carpenters and others engaged in industrial pursuits. We shall also send a portion of our edition to the industrial fairs being held in the various cities of the Union, for distribution there.

Our lists are most complete, being very carefully compiled. They embrace only the names of reliable firms, and by taking advantage of our Special Number advertisers will reach such parties as will doubtless become valuable and permanent patrons.

Manufacturers who have advertised in our former extra numbers have acknowledged their great value, and it is our intention to make the present Special issue of even greater value than those which have preceded it. To this end, our lists have been carefully revised to date, and augmented, and special pains will be taken to have the typography of the number of the highest order.

We hope to receive the same generous patronage which has been accorded us in the past, and have no doubt that advertisers will be quick to take advantage of the opportunity presented. Rates will be the same as for our regular issue, and estimates will be cheerfully furnished.

Schemes for Shortening the Ocean Transit.

"Die Welt wird alt und sie wird wieder jung,
Doch der Mensch hofft immer Verbesserung."
—*Schiller.*

These pregnant lines of the great German, though written to express the sentiment that hope lives always in the human heart, may answer, if translated literally, to express the ceaseless efforts of inventors and constructors to originate and improve.

In no one direction does this ceaseless striving attract more of general interest than in the continuous emulation of the rival steamship companies, each to excel the other, in shortening the time of the ocean transit. Scarce have we ceased to wonder and applaud the remarkable achievement of one of these ocean giants than we are called on to transfer our plaudits to another of more improved construction and more powerful machinery. How soon the limit of highest speed compatible with safety will be attained, is purely a matter of conjecture. We seem to be as far off from this limit in steamship as in railway speed, and in both we are satisfied that, before the close of the present century, the average speed of both will be double what it is at present. No one who is familiar with the rapid progress of the mechanic arts, will pronounce the foregoing estimate to be an extravagant one. The earliest steamships required from 20 to 24 days to cross the Atlantic; in 1846 a passage of 16 days was looked upon as a remarkable achievement; while in our day 8½ to 9 days is the average time of the passage, and some of the swiftest steamers have crossed in less than 7 days, and the improvement will doubtless continue.

One notable scheme having this object in view, is associated with the name of Mr. Lorillard, who proposes to build a splended fleet of steel steamships for passenger service exclusively, which shall be constructed after the best models, and provided with machinery much more powerful than that of any steamer afloat. The avowed object of the originator of this project, which, it is affirmed, is in a fair way to be realized in the near future, is to reduce the time of the Atlantic passage to 5, and possibly to 4, days. If this project is put into execution, it would not be many years before this exceptional speed would have have become the average one, for the rivalry of the steamship companies would not suffer such superiority to exist without competition.

We should not omit to mention in this connection certain highly interesting and novel experiments that for a number of years have been conducted by Mr. Winans, an American gentleman of fortune, and the son of an eminent American engineer. Mr. Winans' experiments have been in the direction of constructing a submerged vessel, and he is reported to have achieved some very remarkable results with a vessel of this type. His experiments have been made in the English channel, and though they have been from time to time commented on in the engineering press, they have not received, in our opinion, the notice they merit, and the general public is quite ignorant of them. Mr. Winan's novel experiments, no doubt, suggested to the inimitable novelist, Jules Verne, his conception of the wonderful 'Nautilus" of Captain Nemo in his entertaining work entitled "Three Thousand Leagues Under the Sea," with which many of our readers are doubtless familiar. Novel and revolutionizing as the idea may appear on first thought, there is much to be said in favor of the conception of a submerged vessel. Such a vessel would be entirely independent of the obstacles which the wind and waves oppose to vessels sailing or steaming on the surface, as the disturbance of the waters extend but a few feet beneath the surface. The submerged vessel would, therefore, glide through still water, and, with the expenditure of much less power, would be enabled to make much higher speed than that with which we are familiar. There are, however, numerous mechanical difficulties to be mastered before a submerged vessel shall be constructed that will be pronounced by naval architects and constructors to be entirely safe and manageable. What the future may have in store for us in respect to this type of vessel, we can only conjecture, but the fiction of Captain Nemo and his "Nautilus" is not all fiction, as Mr. Winans' remarkable experiments bear testimony, and stranger things have happened than the adoption of this novel mode of transit.

The latest scheme for rapid ocean transit which is now being agitated in the newspapers, has a much stronger probability of realization. Though the accounts that have lately appeared concerning it speak of it as new, the scheme has, to our certain knowledge, been mooted repeatedly during the past ten years. All who are at all familiar with the geography of the North American continent, will know that the shortest distance across the Atlantic is in a line drawn from the most easterly extremity of Newfoundland to the west coast of Ireland, the distance across between these points being reduced to almost the half of that between the eastern ports of the United States and the west of Ireland.

The desire to shorten the time of passage between this country and Europe, has given rise to the scheme above referred to, and which takes advantage of the proximity of the promintory of Newfoundland to the British islands. The scheme contemplates a continuous railroad transportation from all parts of this country to some point on the eastern coast of Newfoundland, and steamship transportation from there to the west coast of Ireland, a distance of only 1,640 miles. It is claimed by its advocates that the execution of this project will reduce by at least two days, and possibly by four days, the traveling time between New York and London. This scheme, it is reported, has been quietly advanced for some time by certain prominent persons, and early in the present month a company is said to have been formed to put it into execution, with Dr. Norvin Green, of the Western Union Telegraph Company, as president, and Mr. A. L. Blockman, late general manager of the Newfoundland Railway Company, as vice-president. The company is said to have adopted the imposing title of the Great American and European Short-Line Railroad Company.

Charters have been obtained from the Dominion government and the governments of Nova Scotia and Newfoundland, and work has been commenced on what is called the Oxford division of the road, a

stretch of 70 miles in Nova Scotia, from Oxford to New Glasgow. The idea of this line was derived from a similar line that has long been in successful operation in England. That line crosses England by rail from London to the Island of Anglesey and connects, by steamer across St. George's Channel, with a railroad from Dublin to Queenstown, where connection is made with the transatlantic steamship which sailed from Liverpool ten hours before the train left London.

With the realization of some of the projects named in this brief *resumé*, and the continuous improvements in the arts of naval and machine construction, it is not unlikely that the time of the Atlantic passage may be greatly shortened in the near future.

Mr. Lawson's Experiments.

We print in another column the views of an intelligent correspondent upon Mr. Lawson's system of boiler construction, which was the subject of some editorial remarks in our July issue. So far as the remarks concern ourselves, we have only to say that a careful reading of the editorial alluded to will satisfy our readers, and we hope also this correspondent, that we have neither endorsed nor 'recommended" Mr. Lawson's system of boiler construction. It is yet too early for any one to do either, as the available data upon which to base such an opinion are too meager to warrant the engineer (and especially the editor of a widely-read technical journal) in forming and uttering decided convictions on the subject.

What we have done, has been to place before our readers what we conceive to be a fair statement of facts, as a matter of history, and for future reference. The editorial comments referred to, relate exclusively to the opinions and conclusions reached by the government experts charged with the duty of witnessing and reporting upon Mr. Lawson's experimental tests. We have taken no pains to conceal our commendation of Mr. Lawson "for having shown the engineering world, by the irrefutable logic of experiment, the true value and importance of an active element in the causation of steam boiler explosions which had heretofore been considered of such trifling or questionable importance that it had been passed by with brief comment, or, in most cases, completely ignored;" and we are decidedly of opinion, and have so stated, that for having done so, "Mr. Lawson has rendered a material service to science."

On the subject of the efficiency of Mr. Lawson's system of boiler construction as a preventive of explosions from the cause that he advocates, we have nowhere stated that we endorsed or recommended it. The statements with which we introduced the references to this subject, should make this clear to any one who will take the trouble to read them, namely: "The major portion of the report here referred to dwells upon Mr. Lawson's system of boiler construction, and has a special interest for us on that account, since it expresses very decided opinions on a number of points concerning which we have entertained doubts." We then proceed to give the gist of the conclusions reached by the government experts. It would require an ingenious perversion of these statements to construe them into a recommendation or endorsement. We have stated that thus far Mr. Lawson has discomfited his critics, and on this point the facts we think warrant that opinion. The experiments that have thus far been made certainly tell strongly in Mr. Lawson's favor, and cannot be ignored. The engineering fraternity will in future, we feel satisfied, give the theory of explosions to the demonstration of which his experiments were made, a much more prominent place as a vital cause of such disasters than they would ever have done had they never been made; and until we are enabled by the experience of experiment to positively affirm or deny the utility of the form of boiler construction which he has proposed to guard against it, Mr. Lawson is entitled at least to a suspension of judgment.

Referring now to the subject matter of the correspondence that has called forth the preceding remarks, we have only to say, that where the writer confines himself to advancing mechanical objections to the Lawson system of boiler construction, and to the conditions of the experiments, he stands on proper ground, and his criticisms are reasonable and just; and our columns are open to Mr. Lawson to reply to them should he choose to do so. His comments on the manner in which Mr. Lawson chooses to give the widest publicity to his views and experiments, are, to say the least, in very bad taste, and uncalled for. They do not strengthen, but weaken, the force of his criticisms.

Anti-Patent Legislation.

Our esteemed correspondent whose communication on the above topic appears in another column, asks the very pertinent question, What had best be done to protect the inventors of the country from the danger of the passage by Congress of such destructive measures as that which came so nearly passing at the last session? His suggestion, that the engineering and scientific societies of the country should take an interest in the matter, is a good one, and it strikes us that under the leadership of some prominent and respectable body, united action on the part of all the leading societies of this kind would not be difficult to secure. An earnest collective protest against the passage of any legislation inimical to the interests of patentees, coming from so influential a source, could not fail to make a decided impression, even upon a body so shamefully indifferent to public opinion as the Congress that has lately adjourned. A species of "National Committee on Patents," composed of representatives chosen by the mechanics' institutes, engineering societies, and other prominent technical and scientific bodies throughout the country, might perhaps be constituted, if some one of them would start the idea; and it appears to us there would be no difficulty in securing the hearty coöperation of a number of influential societies in such a proposition.

A committee so constituted should hold meetings at some central locality, at stated periods, to discuss matters affecting the interests of patentees, to suggest reforms and improvements in the existing laws relating to patent property, where they were deemed desirable or necessary; to organize resistance against such infamous and destructive legislation as that proposed at the last session of Congress; and to do many other things that would suggest themselves.

To effectively meet and successfully oppose the enemies of the patent system, who are rich, powerful and organized, will require organized resistance. It is true that much can be accomplished by vigorous individual action, as witness the emphatic and timely protest of the Franklin Institute before the Senate Committee on Patents at the last session of Congress; but it is obvious that the united coöperation of many similar bodies throughout the country would be vastly more effective. Such an organized body as we propose, might be able to accomplish in time much more than the demoralization and overthrow of the powerful combinations formed for the purpose of robbing the inventor of the fruits of his intellectual toil. It might perhaps be able, by its agitation of the subject, to pave the way to securing the unification of the patent laws of all the leading industrial nations, which is "a consummation devoutly to be wished," provided such unification were made to harmonize with the just and liberal spirit that characterizes the patent laws of the United States. This suggestion we only throw out to indicate that the scope of the organization we propose would be quite extensive, and its usefulness limited only by the ability and zeal of its members.

The organization of such a body as that above indicated, as before remarked, would not, in our opinion, be a matter of serious difficulty. In the case of one institution, at least, as we have the best opportunity of knowing, the feeling of indignation and apprehension aroused by the threatened action of the last Congress has had the effect of calling into existence a Committee on Patents, whose duties were so efficiently performed that the question of maintaining it as a permanent committee is almost as good as settled. It will only need the stimulus of another threatened invasion of the rights of patentees to render coöperative action on the part of many similar bodies necessary.

The Hudson River Tunnel.

Though with occasional hindrances and vexatious delays, caused by an occasional cave-in at the headings, the work on the Hudson River tunnel is progressing tolerably well. Work was fairly under way on the New York side, when an accident of this kind occurred a short time ago, and the water from the river overhead burst into the heading and filled it from the further end to the air-lock, 15 feet back. Fortunately none of the men at work in the section were injured. The account of the mishap, as given in the daily papers, is interesting, and we reproduce the essential portions herewith:

The section of the tunnel in which the blow-out occurred is the last one undergoing construction. It extends from the air-lock, which is 50 feet from the caisson—15 feet further towards the river to a point about even with the end of the river bank and the beginning of the river bed. The earth had been tunneled out in this section, and the boiler-like cylinder of iron which is to form the outer shell of each heading of the tunnel was being lined with brick. All the men were in this iron cylinder, working by the glare of an electric light, when suddenly a hissing sound announced their danger. The strong pressure of air which is kept up in the uncompleted portions of the tunnel had found a vent through the sand of the river bed and the made ground overhead, and when it went out water was forcing itself in. The order to retreat to the air-lock was given, and in quick time all made their way into the great iron vessel, whose door closed automatically behind them as the water made its way in and the air pressure was spent. Three minutes elapsed after the first signal of danger before the bulkhead plates gave way and the earth was blown out, admitting the body of water that, when it came, filled the iron shell of the heading in a second. Engineer Clift and his men had been out of harm's way a minute and a half before this took place. The way back to the caisson through the completed part of the tunnel was clear and dry behind them.

The difficulties that will be encountered on the New York side of the tunnel, will be much more serious than those on the Jersey side. There the river bed is composed of a very fine, compact silt, or river mud, than which nothing could be better for the successful operation of the Haskins very radical plan of tunneling laterally through yielding materials without the protection of shields or bulkheads. On the New York side, on the contrary, the river bed through which the tunnel must be driven, is very sandy, and the difficulty of keeping such shifting stuff in place, where a considerable surface is exposed, as it must be with Haskins plan of working, is manifest. We shall probably hear of the frequent recurrence of mishaps like that we have recorded above, but trust that the experience gained during the work will have suggested the most ample precautions against injury or loss of life among the workmen.

The Labor Troubles.

Our opinion as to the futility of the extensive labor strikes inaugurated over the country some months ago, and which caused much uneasiness in business circles, has been shown to be correct. Except in a few unimportant cases, the men who so foolishly followed the behests of the demagogues who are responsible for misleading them, have yielded to the in-

evitable, and are now clamoring for employment at the old rates they rejected some months ago, or at any wages they can command. It is the old story of poverty, wretchedness and want following on the heels of folly. The millions of dollars they refused as wages during the weeks of their voluntary idleness, are lost to them forever, and their last condition is worse than their first.

Scientific Meetings.

The past month has witnessed the meetings of two important scientific bodies in this country, and many similar bodies in European countries. The American Association for the Advancement of Science held its thirty-first annual meeting this year in Montreal, beginning August 23d. The meeting was most successful, both in the number of members and visitors attending the sessions, and in the character of the papers, which were generally of a high order of merit.

Just previous to the Association meeting, the American Congress of Forestry held its second meeting in the same city, which was participated in by several hundred gentlemen interested in the subjects of the culture and care of forests, which promise in the near future to become matters of the gravest importance to this country where the destruction of forests is going on at a rate that must soon cause very disastrous results, if measures are not speedily taken to check it and provide for their restoration. We shall take the opportunity in our next month's issue to present in our columns of Science News a *resumé* of the more important papers presented at these meetings.

Our Forest Wealth Illustrated.

The paper read before the Forestry Congress at Montreal (Canada) by Superintendent Bickmore, of the New York Museum of Natural History, will give many of our readers their first knowledge of Mr. Morris K. Jesup's generous provision of the funds necessary for a collection to illustrate the forest wealth of the United States. Of the 429 arborescent forms of vegetation growing spontaneously in this country, 375 have already been secured. It is proposed, also, to secure as many species as are adapted for this climate to be planted in the grounds surrounding the Museum and in Central Park, the whole being catalogued so that visitors may become familiar with each species by name. The influence of the Jesup collection will vastly exceed that of the learned papers prepared to awaken interest in the preservation of American forests. All the people who live in New York, and all the people who come to New York, will wish to visit the collection, and the result will be highly beneficial in several respects.

The Forestry Congress at Montreal considered, among others, the following topics: How to preserve existing forests; the best methods of working timber lands in the interest of holders, the public and the revenue; the duties of the government in regard to forestry; the best trees to plant; shade-tree and fruit-tree cultivation. Much is hoped from the work of the congress, but vastly more good may be expected from the Jesup collection.

New Discoveries of Amber are reported to have been made in and about Berlin. These are said to be so promising, both in quantity and quality, that the prediction is made that this region will in time become a competitor in the amber supply with the fishing stations on the Baltic. In one place in the city, during a single week, more than a hundred good sized pieces were dug up. In the Landgrafenstrasse, in an ancient alluvium, about 12 feet below the surface, what appears to be a bed of amber was found. In the immediate neighborhood of the city a similar discovery has been made. The discoveries are both interesting and important, and surprise is expressed that the presence of amber in so populous a district should have remained so long unsuspected.

Improved Anti-Friction Bearings.

In our issue for October, 1881, we described an anti-friction bearing, invented and manufactured by John G. Avery, of Spencer, Mass., and designed to be applied to shafting, heavy team wagons, road

Fig. 1.

wagons, expressmen's trucks, paper-mill rag engines, circular saw arbors, miners' drilling machines, bicycles, etc.

This invention consisted of a series of hardened steel rolls, contained within a shell, and so disposed that in the six or more rows no two of the rolls were in the

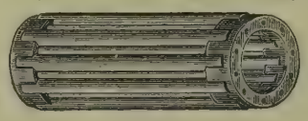


Fig. 2.

same line. The journal of hardened steel revolved entirely upon these rolls, and consequently greatly reduced friction.

Mr. Avery has lately modified the construction of these bearings, and while retaining the same principle and the same general features of construction that characterized the very successful invention above re-

Fig. 3.

ferred to, has made certain changes that simplify it, and for many applications increase its durability in service and general efficiency. These new improvements are illustrated in the accompanying engravings (Figs. 1 to 5). They are so simple that the cuts almost explain themselves, and all who were suffi-

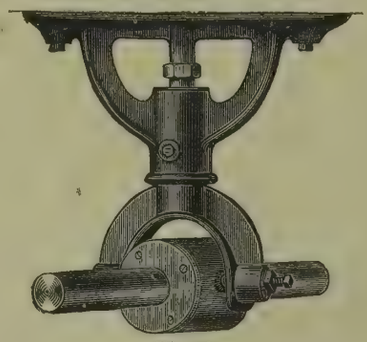


Fig. 4.

ciently interested to read our description of Mr. Avery's original invention, will understand the modification at a glance.

Figs. 1 to 4 represent the improved anti-friction bearing as applied to shafting. Fig. 1 is a hardened tube that slips over the shaft. Fig. 2 represents the friction-reducing device, consisting of circular end

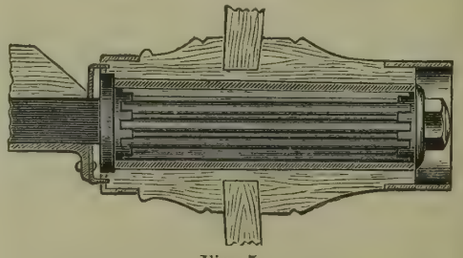


Fig. 5.

pieces, joined together by shouldered rods of hardened steel, and provided with a series of rolls of hardened steel which are free to move between the rods. This "anti-friction shell," as the inventor terms it, is fitted on over the hardened tube above described. Fig. 3 is a box, internally hardened, and is fitted on over the roller cylinder. Fig. 4 represents the hanger, with anti-friction bearing complete, the ends of the roller box being closed by caps. By his method of construction, Mr. Avery claims to have been able to secure a perfection of parallelism not heretofore attained in any other form of bearing.

Fig. 5 represents the improved friction-reducing device attached to a wagon axle, which requires no further description.

From the above, our readers will be able to form their own opinions of the efficiency of Mr. Avery's invention. He claims that where his bearings are used, no lubricants are needed, and "hot boxes" are impossible. He likewise affirms that with their use a saving of one-third in power will be assured.

The bearing is being exhibited at the New England Manufacturers' and Mechanics' Institute Fair, Boston, where it can be seen on a balance wheel weighing a ton, No. 8 spool cotton being used as a belt to run it.

Mr. Avery may be communicated with, at the address above given, for further information on points that may have been overlooked in this description.

Anti-Patent Legislation.

To the Editor of the Manufacturer and Builder:

I much admired and appreciated your editorial remarks on page 112 of current volume, in relation to the anti-patent legislation. I also fully endorse the remarks on the next page, in relation to the liberal patent laws stimulating invention.

I once had an experience in London in obtaining a patent, and succeeded, after six months worry and an expenditure of about $400; and having since taken out several United States patents, can understand the difference. I have also been acquainted with several persons of various nationalities, who, like myself, were encouraged to make improvements here which in their own countries they would have let lie dormant for lack of such stimulus.

What do you suggest as best for the inventors and manufacturers to do, in view of the narrow chance of such legislation having been ratified in the last Congress? I would suppose that all the engineering and other scientific societies would be interested in opposing such rascality.

Where would the present race of farmers be if all the improvements that have been the result of the patent laws, were to be swept away, and they were relegated to the old tools and implements of fifty years ago? They would be simply worse off than any other class in the community.

I can scarcely feel surprised, however, at any legislation from the late Congress, as a body of men who could so far forget themselves as to pass the Edmonds bill and the Chinese bill, trampling under their feet the Constitution they had sworn to uphold; and also to ignore the proposition for a Board of Tests, so necessary to the interests of the engineering profession, were fully prepared and qualified to rob the inventors of the country in order to gain a little notoriety. Yours, etc. Wm. J. Silver.

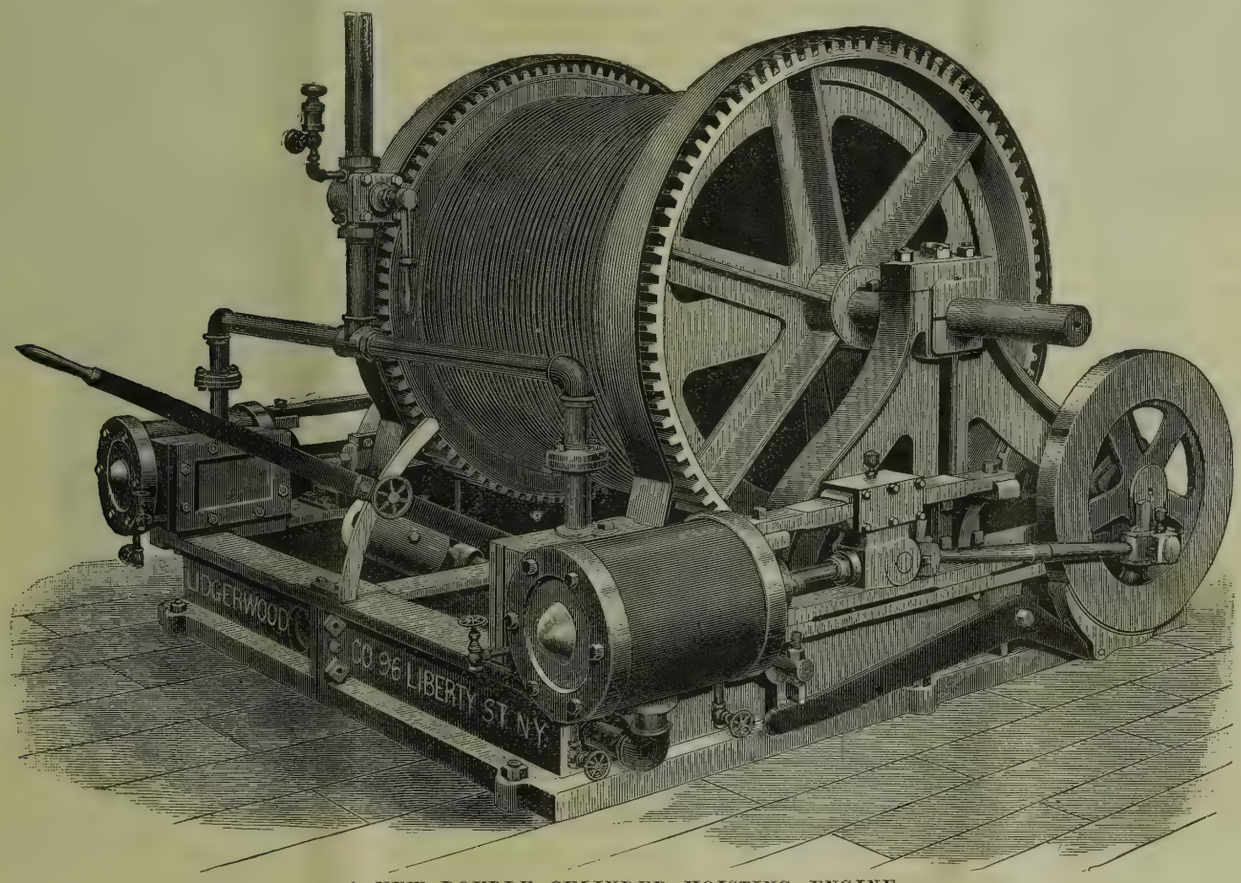
Salt Lake City, U. T., August 28, 1882.

The Mechanics' Fair at San Francisco.

The seventeenth industrial exhibition of the Mechanics' Institute, at San Francisco, Cal., was inaugurated on Tuesday, August 15th, with the usual ceremonies. The present exhibition is invested with additional interest from the fact that it is the first held in the new pavilion, a large structure recently erected for exhibition purposes. The opening of the exhibition was entirely satisfactory. Every department of art and industry is well represented by local and other exhibitors, the space having all been taken. The premium list of this exposition is quite varied and extended, there being eleven divisions with forty-seven classifications.

Improved Double Cylinder Hoisting Engine.

The improved hoisting engine shown in the accompanying illustration is manufactured by the Lidgerwood Manufacturing Co. of this city, of whose machinery we have had occasion to speak on former occasions. The cut is that of a 50 horse-power, double cylinder hoisting engine, designed especially for mining purposes, and provided with certain conveniences of construction to adapt it in the best manner to the conditions of its special service. One very important practical requirement that has been held in view in its design, relates to the necessity, in machinery of this class, of being taken down, transported and set up repeatedly; and to meet these conditions, the engine has been so constructed as to permit of its being taken apart, transported and put again in working shape without the necessity of calling in skilled labor, and without encountering trouble in its proper alignment, which is often a serious objection to machinery of this class. To meet these practical requirements, each of the cylinders is bolted upon a separate bed-plate, together with its link, brake, pillow blocks and frame for carrying the drum shaft. These two bed-plates are bolted together, the steam and exhaust pipes are connected by flanges, the two shafts put in place, and the engine is ready for operation.



A NEW DOUBLE CYLINDER HOISTING ENGINE.

To avoid the occurrence of accidents by the breaking of gear teeth, or the working loose of keys, the engine here shown has two pinions keyed upon the engine shaft, which mesh into two spur gears upon the drum shaft. Again, in the construction of this engine, the drum is finished and keyed to the shaft separately, as are also the large gears at the ends, thus greatly reducing the likelihood of accident from the working loose of keys.

The gears and pinions are not cast from wooden patterns, but from metal patterns made in the following manner: A gear blank is cast and cut in a regular gear cutter, which insures precisely true patterns, so that the gears cast from these patterns run almost as well as cut gears. The shrinkage of the metal in casting makes a less difference than might at first be supposed. With gears made from wooden patterns, the shrinkage and changes constantly taking place are a continual source of annoyance. With wooden patterns it is necessary to allow considerable draft to get the patterns out of the sand, and in fitting up it is necessary to put the thick ends of the teeth in the two wheels at opposite sides to insure a good bearing of the teeth, otherwise they will all bear at one end.

The automatic brake with which these engines are provided consists of a shoe under each crank wheel, and attached to the end of a lever pivoted to the bed plate, as may be seen by inspecting the engraving. This lever is operated by a bolt having a head flattened, and tapped through the end of the reversing shaft. The bolt can be adjusted to compensate for any wear of the brake shoes, and is held by a jam nut. When the reverse lever is placed in its central position, as shown, the links are at mid-gear, and the automatic brake prevents any movement of the engine. On the smaller sizes of these engines this lever is connected with the throttle, so that when it is thrown either forward or back the automatic brake is released, the links are thrown, and the throttle opened which starts the engine. It will thus be seen that the engine may be manipulated by the simple movement of one lever.

To adapt the engine to quick running, the valves are made of the plain D-slide pattern, and with ports of large dimensions. The piston rod, valve rod, cross-head pin and link pins are made of steel, and the boxes and pillow blocks are lined with babbitt. The bolts and nuts used about these engines are of Low Moor iron, and will interchange. All parts are made to standard gauges, and after being put together tapered steel pins are put through them so that they can be easily replaced should occasion require them to be taken apart. Each size of engine has a separate and complete set of patterns, and in no case are larger cylinders put upon a bed-plate belonging to a smaller size. The gears are covered by guards to insure safety.

As above remarked, the makers, in the design of this engine, have had particular regard for convenience of taking down, transporting and re-erecting it, the necessity for which in mining operations is of frequent occurrence. When it is desired to move one of these engines, the drum and engine shafts are removed, the steam and exhaust pipes disconnected, and the bed-plate taken apart in the center; the parts can then be easily transported. The engine here represented is of 50 horse-power, having 10×12-inch cylinders. The largest size built of this style is 100 horse-power, of which there are a large number in use. They are used in working shafts about 1,000 feet deep.

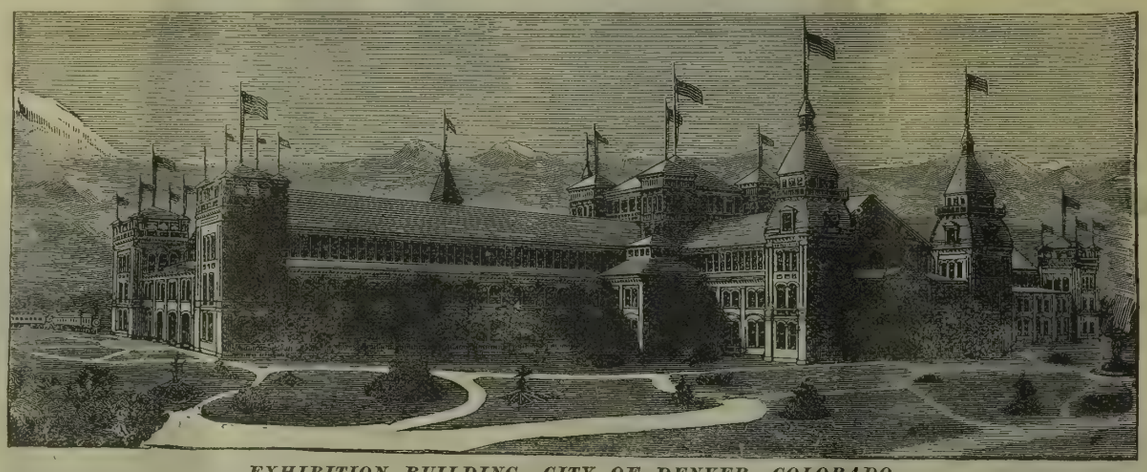
The makers have devoted special attention for years to this class of machinery, and their machines have met with pronounced success. Of late the capacity of their works has become insufficient to meet the demands of their growing business, and they have been obliged to considerably extend their works, as the following news item from one of our technical contemporaries indicates: "The Lidgerwood Manufacturing Co., of Brooklyn, salesrooms at 96 Liberty street, New York, is just moving into its new shops. The ground occupied is 200 by 450 feet. The machine shop is 75 by 200 feet, two stories high; boiler shop, 50 by 200 feet; foundry, 50 by 150 feet; blacksmiths' shop, 40 by 80 feet. The company is fitting up these buildings to produce 75 hoisting engines complete per month. It has now over 1,530 engines in use, doing every conceivable kind of hoisting, and has on its list 130 different styles. An engine is produced from the rough castings and forgings in from six to seven days from receipt of order, in case of necessity.

Cement for Leather Belting.—Soak common glue and isinglass (equal parts) for about ten hours in just enough water to cover them. Bring gradually to a boiling heat, and add tannin until the mass becomes ropy. Buff off the surfaces of the leather where it is to be cemented; apply the cement thoroughly to the parts to be joined; then warm the parts over a flame or fire for a few minutes, join the two parts properly, clamp firmly or weight them, and allow to remain undisturbed over night, when the belt will be ready for use. This cement is said to make a very strong joint.

The Denver Exhibition.

No more striking evidence of the wonderful growth of the far West could be desired than is afforded by the holding of a great National Mining and Industrial Exhibition in the city of Denver, Colorado. The preparations for this event have been going on for many months, and the results bid fair to be of substantial benefit to the State and most gratifying to the projectors. The announcement of the exhibition has had the effect of attracting a large number of visitors from the Eastern States; and the opportunity that will be afforded them of examining in collected form the evidences of the vast mineral wealth and industrial possibilities of the Western States and territories, cannot fail to exercise a mutual beneficial influence on the business relations of the two sections.

The exhibition, which is being held in the imposing structure shown in our illustration, was formally opened on the first of August, in the presence of an immense throng of people from all parts of the country. All places of business were closed on the opening day, the city was gaily decorated, and the occasion was celebrated as a public holiday. The opening address was delivered by the Hon. William D. Kelley, of Pennsylvania, who delivered a most appropriate address, in which forcible allusion was made to the future industrial prospects of the State of Colorado.



EXHIBITION BUILDING, CITY OF DENVER, COLORADO.

The exhibits of minerals and mining machinery and processes are immense in quantity and very comprehensive. The railroad companies especially make fine displays of the resources of the country along the lines of their roads. The Atchison, Topeka and Santa Fé Railroad Company has an extensive and tastefully arranged display of cereal products raised along its line. The Union Pacific Railroad Company exhibits a large display of minerals, woods and other products of the country through which its line passes; and the same may be said also of the Denver and Rio Grande and other railroad companies.

The presence of representive mining engineers and metallurgists from every section of the country, is assured by the meeting of the American Institute of Mining Engineers, which held its summer session this year in Denver; and this fact alone will doubtless be productive of results of special value.

It is contemplated also by the managers of the exhibition to hold a convention representative of the leading industries of the United States in Denver, on the 12th and 13th days of September. This convention is intended, as we learn from the official call that lies before us, to embrace representatives of the manufacturing, commercial, mining and agricultural interests of the whole country. The call for this convention is issued by the Board of Trade of the city of Denver, and from all appearances will meet with a hearty response. The following are among the questions of national importance that will be discussed: First. The Monetary Question—Is it for the best interests of the citizens of the United States to have silver demonetized? Second. The Immigration Question—Is increased immigration desirable? Should Chinese immigration be restricted? Third. The Labor Question—Are strikes and trade unions a curse or a blessing to the laboring classes? Fourth. The Tariff Question—Is protection necessary to the growth of American industries?

The exhibition promises to be in all respects a representative and a most successful one; and from the great number of representative business and professional men from all sections which it has attracted to Denver, it will doubtless result in giving a new impulse to the already remarkable development of Colorado and her neighboring States and territories.

Stupendous Engineering Operations.

Parts of Colorado, New Mexico and Arizona, in plats of hundreds of thousands of acres, are level and ready for the farmer, only that there is no water. The rivers running much higher than these valley or table lands, offer abundant water for irrigation, provided that ditches or channels be cut and dams constructed to divert the water to them. There are numerous enterprises of this kind already in operation upon a moderate scale, and recently an English company has undertaken the cutting of a channel in central Colorado, which will render some 200,000 acres fertile and ready for the farmer's crops. Another stupendous undertaking of a similar kind is on foot by the Colorado Coal and Iron Company. This channel will be opened from a point on the Arkansas River 3½ miles below Cañon City, and be extended across the table-land in a southeasterly direction to the St. Charles River. The ditch will be 30 feet wide and 76 miles long, carrying 5 feet of water. Such enterprises are the feature of the new development of this new country, and are watched with much interest.

Fair of the New England Manufacturers' and Mechanics' Institute.

The grand opening of the second annual exhibition-fair of the New England Manufacturers' and Mechanics' Institute took place in their mammoth exhibition building, on Huntington avenue, Boston, Wednesday, September 6th. The exhibition far surpasses the brilliant display of last fall. Exhibits from twenty-seven States of the Union, and from three foreign countries, completely fill the immense building. The genius of the inventor and the skill of the mechanic are displayed in a thousand forms. Illuminated water displays, cascades and fountains add a charm to the busy interior. The great Southern Railroad exhibit, a repetition of the Atlanta exposition, is of much interest; the ores, minerals, woods and field products of the South are fully represented. Another attractive feature of the exhibition-fair is the great electric light display by Professor Edison and others. One thousand incandescent lights of Edison's system, and one thousand arc lights of other companies, illuminate the vast interior at night.

As before stated, the opening ceremonies took place on Wednesday, September 6th, at 11 oclock A.M., Governor Long presiding, assisted by the governors of such other States as are represented by extensive exhibits. Mr. Edward Atkinson delivered the address, and Reeves' American Band, of Providence, enlivened the occasion with choice musical selections.

Painting the East River Bridge.

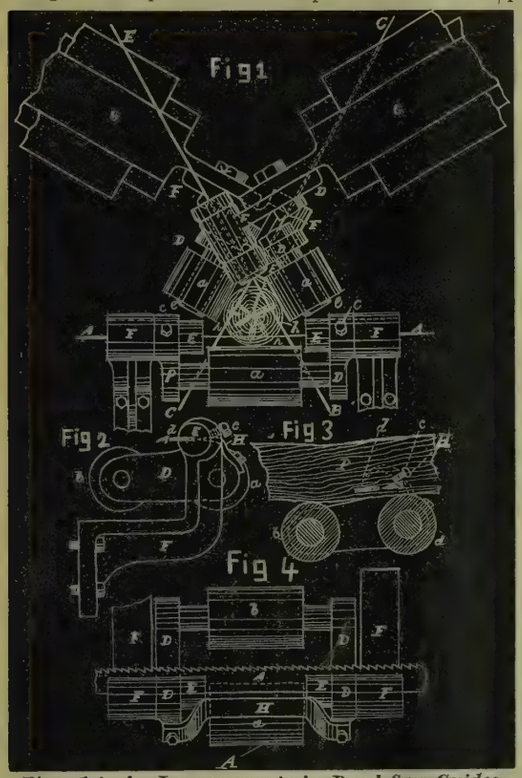
For ways that are dark, the Brooklyn Bridge Commission, like the heathen Chinee, is certainly peculiar. Ten thousand gallons of paint, more or less, are required for the bridge. This is to be obtained by a series of bids. Sealed proposals were recently offered, and the prices ranged from $1.60 down to 90 cents per gallon. The formula by which the paint is to be mixed, like the ways of the commission, is most peculiar. There are to be "70 pounds first quality white oxide of zinc, 30 pounds best white lead, 6 gallons raw Calcutta linseed oil, with such staining material as may be necessary to produce the color desired. The paint must be thoroughly ground, and must not weigh less than 18 pounds per standard gallon." This, to say the least, we think is an injudicious formula. In the first place, made up with all honest intention, so as to give as good a paint as the formula is capable of making, the weight will be but 17¼ lbs. per gallon. Sealed up in tin cans this paint will weigh just 18 lbs. per standard gallon. If this formula does not leave room for unlimited skinning, we think it would be difficult to devise one. In the choice of lead and zinc there is no limitation whatever. The manufacturer can buy this, that or the other zinc, which will be warranted him as "first quality," or the "best." The linseed oil may be Western, and, after being mixed, we think it very doubtful whether there is any one connected with the bridge who will be able to say anything in regard to its quality. A better proportion would have been 50 pounds of zinc to 50 pounds of lead. It is evident, from reading the specification, that the paint is altogether too thick for use unless dryers and thinners are added. If the company intend to add these themselves, and if they know enough to specify what the proportions of the paint should be, it would have been vastly better for them to have bought the materials in the market and set up a small paint mill, and ground as they needed it.

It is already 25 per cent too stiff, according to the opinion of those qualified to judge. The loophole left in the coloring material clause, in the hands of an honest contractor would not amount to anything, but it might be the means for introducing a very heavy percentage of material that would be, to say the least, utterly worthless, and, possibly, harmful. The raw materials of really the very best quality in the market, we suppose, will cost about $1.13 at the present time, from which it will be easily seen that those who bid 90 cents did not intend to come nearer than the letter of the law in using "best white lead" or "best oxide of zinc."

The contract, we learn, has been awarded at $1.15, leaving the manufacturer a profit of 2 cents per gallon. If they get what they specify, this is cheaper than they could make it—cheaper, in fact, than the manufacturer can make it.

Recent Improvements in Wood-Working Machinery.

Figs. 1 to 4 represent certain improvements in band saw guides, designed to facilitate the sawing of barrel hoops from poles, patented by William Bowker, of Somerville, Mass. Fig. 1 is an elevation of parts of three band saws provided with the improved mechanism for guiding each and bending it laterally to cause it to cut into the pole a kerf in parallelism with the surface, which may be borne along against the pressure roller. Fig. 2 is an end view of the saw guiding and holding mechanism, and one of its supporting brackets; Fig. 3 a longitudinal section, and Fig. 4 a top view. A B C, Fig. 1, are parts of three band saws as arranged for sawing three hoops from a pole P. Each hoop portion of the pole, while it is being fed to the saws, bears against the two rollers of one of three sets of pressure rollers *a* and *b*. This arrangement is shown in Figs. 2, 3 and 4, in which the horizontal roller *a* and its fellow *b* are shown as arranged within and supported by two swinging levers D D, each provided with one of two journals E. These journals extend through and project from the levers in opposite directions, and are secured by a set-screw *c*. They also rest and turn in stationary brackets F, and each is grooved at *d* to receive a saw, as shown in the engravings. Each of the two upper inclined rollers *a* and its fellow *b* are supported on journals *e* projecting from a single swinging lever D, projecting from and fastened to a cylindrical journal E, having its bearing in a bracket F. The bracket projects from a slider G, which in practice is provided with a spring to force it forward and allow it to move backward. By means of this spring the pressure roller *a* and its fellow *b* are forced up against the hoop portion of the pole while the pole is being advanced and sawed. By the pressure downward upon the pole by the two upper sets of pressure rollers *a b*, the pole is borne down upon the horizontal set *a b*. As the pole may advance, each saw will, by being in its groove *d*, be maintained at one uniform distance from its two guide rollers *a b;* but as the surface against which these rollers may bear may be more or less winding or sinuous, the lever or levers D supporting such rollers will be vibrated so as to cause the grooved journal of each of such levers to turn more or less, so as to bend the saw laterally into parallelism with each sinuosity, in order to cause it to cut the hoop so that its inner side may be substantially parallel to the line of its outer surface.



Figs. 1 to 4.—Improvements in Band Saw Guides.

From the above it will be seen that, however irregular in diameter or knotty the hoop pole may be, the two rollers *a b* and their supporting lever or levers D, and the grooved journal of each of such levers, will not only cause the hoop pole to be cut with a uniform thickness along its median line, but will tip or bend the saw laterally, as occasion may require, to cause it to maintain its parallelism with the said longitudinal median line of the outer surface of the hoop.

Fig. 5 is a perspective view of an improvement in machines for boring fellies of wagon and other wheels, or other curved pieces of timber, and for other uses, designed by Vincent Cox, of New Vienna, O. The cut shows the machine applied to a felly. It allows the boring of holes in these and other articles, both in straight lines and in various angular directions, without shifting the article which is being bored. Referring to the cut, A is the frame or stand on which the article to be bored is placed, and secured by the clamping screw C. The frame is formed of a base *a*, on which the article rests, and an open guard *b* against which the inner side of the article bears. Attached to and projecting centrally and horizontally outward from the front of this frame is an arm D, having an eye *l* opening up through its outer end and fitted with a side set-screw *c*, for holding in place, as adjusted up or down or around within said eye, a circular post E. This post is also constructed with an eye *d* at its upper end, whereby it is made to form the bearing post for the shaft or rotating holder G, which carries at its inner end the bit or auger G′, and which shaft corresponds with the shank of the bit or auger. This shaft G is fitted to work loosely or freely through the eye *d* of the post, and is provided on its outer end with a crank or handle *e* for operating the bit or auger. With this tool a hole may be bored through the felly parallel with the arm D, or at any desired angle thereto, and inclining up or down or to the right or left. The rolling bearing surface of the shaft G renders it unnecessary, for ordinary variation in the angular direction of the holes, to disturb the bearing of the shaft. A centering projection *f* on the base, in line with the arm D, is provided to facilitate the adjustment of the felly on the frame and the proper direction of the bit at starting.

Fig. 6.—Improved Adjustable Cutter Head.

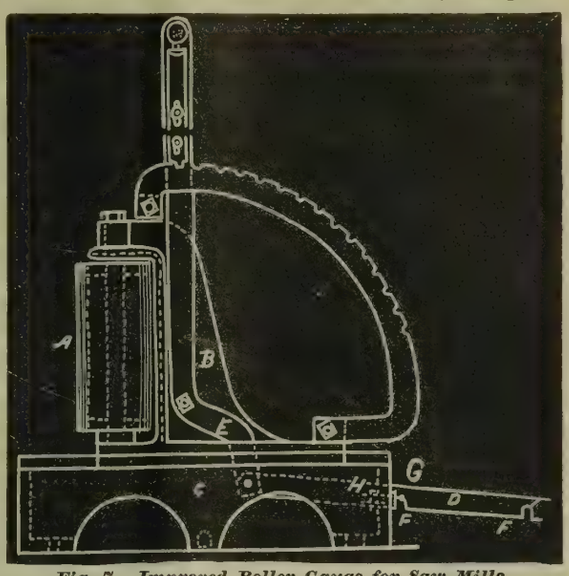


Fig. 7.—Improved Roller Gauge for Saw Mills.

Fig. 6 is a representation of an improvement in adjustable cutter heads, patented by George W. Amesbury, of Philadelphia, Pa. The inventor makes the following claims to novelty: 1st. An adjustable cutter head for wood-working, composed of two flanges or disks carrying independent and disconnected posts or cutter holders, and set or retaining screws for such cutters, the posts on each flange passing into openings in the opposite flange, so as to lock or connect said parts together. 2d. An adjustable cutter head for wood-working, composed of two flanges or disks carrying posts or cutter holders, the free ends of the holders of one disk entering openings in the opposite disk, and means for adjusting said disks to and from each other. 3d. An adjustable cutter head for wood-working, composed of two disks with posts or bolts secured thereto, the free ends of such posts entering openings in said disks, and means for securing the

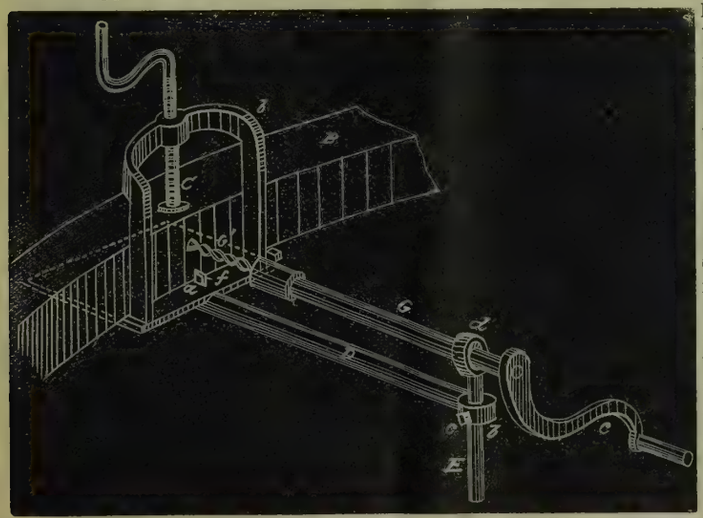


Fig. 5.—An Improved Machine for Boring Fellies for Wagon Wheels.

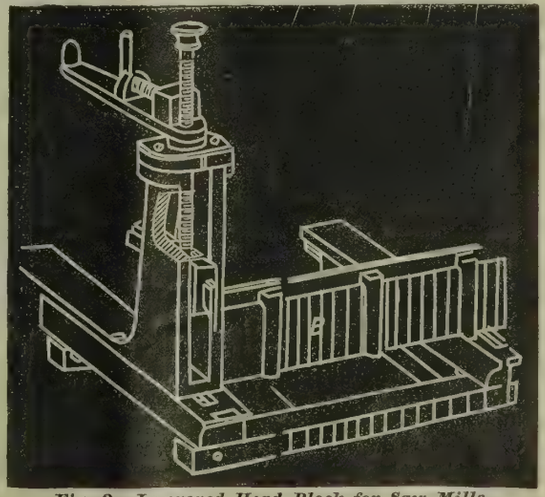


Fig. 8.—Improved Head Block for Saw Mills.

parts in position. 4th. An adjustable cutter head composed of two members carrying interlocking cutter holders, one of said members having a depending slotted lug through which passes a set-screw which engages with a hub formed on the opposite member to hold said parts rigidly together when adjusted.

Fig. 7 represents an improvement in a roller gauge for saw mills, invented by Robert M. Beck, of Westminster, Md. The following points are claimed as novel: 1st. The combination, with the lever E and its retaining segment, the bracket B carrying the roller gauge, and the bed-piece C of the bar D, pivoted to the lever, and having a series of recesses F for forming an adjustable connection with the bed-piece, substantially as shown. 2d. The combination with the lever E and its retaining segment, the bracket B carrying the roller gauge, and the bed-piece C of the bar D, having recesses, and the retaining support G, secured to the bed-piece and adapted to serve as a compensating device. 3d. The combination with the lever E, having a double elbow at its lower end and pivoted to the sliding bracket of the quadrantal segment J, secured to the sliding bracket and extending from a horizontal to a vertical plane, substantially as shown and described, whereby the relative position of the lever and its retaining segment shall remain unchanged when the bar D is moved from one adjustment to another.

Fig. 8 represents an improvement in head blocks for saw mills, invented by Robert M. Beck, of Westminster, Md. The following points are claimed as novel by the inventor: 1st. The combination of the slotted standard, the dog arranged therein, the threaded rod, rigidly connected at its lower end to the dog and adapted to fall therewith by force of gravity, and the crank adapted to rotate in a bearing formed in the standard, and having means for engaging at will with the rod to force the dog into the log, substantially as shown. 2d. The combination, with the standard supporting the dog, of the log beam forming a part thereof, and having wooden fending strips vertically dovetailed therein at suitable intervals apart, substantially as shown, whereby the bearing surface of the log beam may be kept even by reducing the strips with the saw when worn.

Building Intelligence.

Architects, Builders and Contractors are invited to send us items of interest for this department. It is our object to notice only the more important operations in building, our space being too limited for the publication of minor matters, which, besides, possess only local import. We wish to publish only such intelligence as is of general interest.

NEW YORK CITY BUILDING ITEMS.

Six dwellings are to be built by A. H. Barney at Sixth avenue and Fifty-fifth street, at a cost of $90,000.

Twelve new dwelling houses are to be erected on Park avenue, between Sixty-ninth and Seventieth streets. They are to cost $300,000. William H. Browning is the owner.

Annie A. Moore proposes to erect five flat houses on the plot of ground on the northwest corner of Madison avenue and One Hundred and Ninth street, 100 feet 11 inches by 75 feet.

The Jordan L. Mott Iron Works Company are to erect three buildings, to be used as a foundry, machine shop, and engine house, on the west side of Third avenue, 150 feet west of the Harlem River, at a cost of $90,000.

F. C. Linde & Co., propose to erect an extensive six-story brick warehouse on the south side of Thirty-third street, east of First avenue. It will be 50 by 100 feet, and the plans are being prepared by H. J. Schwarzmann & Co.

C. Baxter is drawing plans for a five-story flat house, 25 by 75 by 100 feet, to be erected on the south side of Forty-second street, 105 feet west of Second avenue. It will have a brick front, and on the first floor there will be two stores.

The trustees of the Cornell Methodist Episcopal Church have filed a plan for the erection of their building on the north side of Seventy-sixth street, 153 feet west of Second avenue, to cost $40,000. The front is to be of brown and Ohio stone.

John H. Friend is engaged on designs for two five-story apartment houses, to be erected on the south side of Eighty-first street, 175 feet west of Lexington avenue. They will be 21 by 92 feet by 102 feet 4 inches each. The owners are Mary F. Morris and Mary Cahill.

Thom & Wilson are preparing designs for two five-story brown stone apartment houses, to be erected on the south side of One Hundred and Twenty-sixth street, between Seventh and Eighth avenues. They will be 20 and 30 feet front respectively, and, it is estimated, will cost $40,000. The owner is E. C. Coggeshall.

Pottier & Stymus will erect an extensive building, to be used for show-room purposes, on the east side of Fifth avenue, between Forty-first and Forty-second streets, with an L fronting on Forty-second street. S. D. Hatch is now at work on the plans for this building, which it is estimated will cost at least $100,000.

A handsome apartment house is to be erected on the northwest corner of Seventh avenue and Fifty-fourth street. It is to be a five-story Philadelphia brick and Berlin structure, 25 by 95 feet, and will be trimmed with hard wood, and will cost $30,000. The architect is J. Stroud, and the owner Mr. Lawrence.

James Fettretch proposes to commence the erection, without delay, of two five-story flat houses on the plot of ground just purchased by him on the south side of One Hundred and Twenty-eighth street, between Fifth and Sixth avenues. They will each be 37 feet 6 inches wide, and have all the latest improvements. The fronts will be of brick, richly trimmed with terra-cotta, and it is estimated that the cost will be about $100,000. The architects are Cleverdon & Putzel.

D. & J. Jardine are making the preparatory sketches for a new church building for the congregation of the Emmanuel Baptist Church, which is now located on Allen street, near Grand, and of which the Rev. Samuel Alman is pastor. The new church will be erected on the plot of ground on Suffolk street, near Grand, 75 by 100 feet, and will have an ornamental brick front with stone trimmings. There will be a seating capacity of 500, and the entire cost of the building will be about $30,000.

D. &. J. Jardine are at work on plans for a new church edifice for the congregation of St. Timothy's Protestant Episcopal Church. This church is now located on the north side of Fifty-sixth street, between Eighth and Ninth avenues, the ground extending through to Fifty-seventh street. The old building will be torn down, and the Fifty-sixth street front will probably be utilized by the erection of private houses. The new church will be an irregular stone structure fronting on Fifty-seventh street, 78 by 110 feet, with a seating capacity of 750, and will cost about $35,000.

The new Metropolitan Opera House at Thirty-ninth street and Broadway, besides being, when completed, the largest and roomiest theater in America, will contain some features in the manner of construction which are new to this city. The stage will be entirely shut off from the auditorium, when occasion requires, by means of a fire-proof curtain and a wall extending from the proscenium arch above the roof. The orchestra will be seated on a platform slightly elevated above a pit 48 feet in length by 3 in breadth, with a depth of 14 feet. This pit is shaped like an inverted arch, and its double walls will act as a large sounding-board. The stage will be 100 by 84 feet, with a hight of 93 feet. The walls of the building have been carried about 35 feet above the street level. The structure will probably not be completed in less than a year.

The managers of the New York Foundling Asylum, which occupies the entire block bounded by Lexington and Third avenues, Sixty-eighth and Sixty-ninth streets, have had in process of construction for some time past a new hospital building at the northeast corner of the block, fronting on Third avenue and Sixty-ninth street, which is now fast approaching completion, and will prove a very great and important addition to the main institution. It is of good size, measuring 50 by 75 feet, and in its external appearance will resemble the St. Anne's Maternity Hospital, which also belongs to the Foundling Asylum, at the northwest corner of the same block—at Lexington avenue and Sixty-ninth street. The new hospital, which is being fitted up with every convenience, has already cost upwards of $70,000, and will be used for all cases of sickness not provided for in the Maternity Hospital. It is built of Philadelphia brick and light stone, and is being so arranged that all cases of contagious diseases can be completely isolated from other cases. When finished the building will accommodate about 100 patients.

MISCELLANEOUS.

Plans are being prepared by Mercein Thomas, architect, for a four-story brick and terra-cotta front apartment house, 22 by 70 feet, to be erected on Cumberland street, Brooklyn, N. Y. The building will show various novel and convenient features, and will cost about $14,000.

Parfitt Bros. have drawn plans for a four-story brick dwelling, 37 by 65 feet, to be erected at Nos. 107 and 108 Livingston street, Brooklyn, N. Y. The builders are W. H. & H. D. Southard.

Plans for a hospital to be erected at Scranton, Pa., in pursuance of the bequest of Moses Taylor, have been drawn by an architect of New York city.

English domestic villas have become popular, and plans are being drawn for one to be erected by W. L. Vandervort, of South Oyster Bay, L. I., to be built near the seashore, its construction being of wood, with ornamental chimneys in brick and terra-cotta. One of similar design is to be built of red sandstone, at an expense of about $15,000, for W. J. Russell, of Short Hills, N. J. It will have three tall outside chimneys.

The Illinois Central Railroad is to begin at once the erection of a depot at Chicago, where the ruins of the former depot (burned in the great fire of October 9, 1871) still stand. It will cost over $500,000, and will be completed in 1883. It will be jointly occupied by the Illinois Central, the Michigan Central, the Baltimore and Ohio, and the New York, Chicago and St. Louis railroads.

Arrangements have been made to extend the Manhattan Beach enterprise on the eastern end of Coney Island, by filling in beyond the Oriental Hotel, back of dikes to be constructed on the ocean front, and by the erection of from fifty to seventy-five cottages between the Oriental and Point Breeze. The cottages are to be in the Queen Anne style, to cost from $7,000 to $20,000 each, and they are to be rented handsomely furnished. A broad boulevard will be constructed in front of them, and extended to connect with the Ocean boulevard. Contracts are to be made so that the work will be finished by the opening of next season. The improvements will cost, it is said, about $1,000,000.

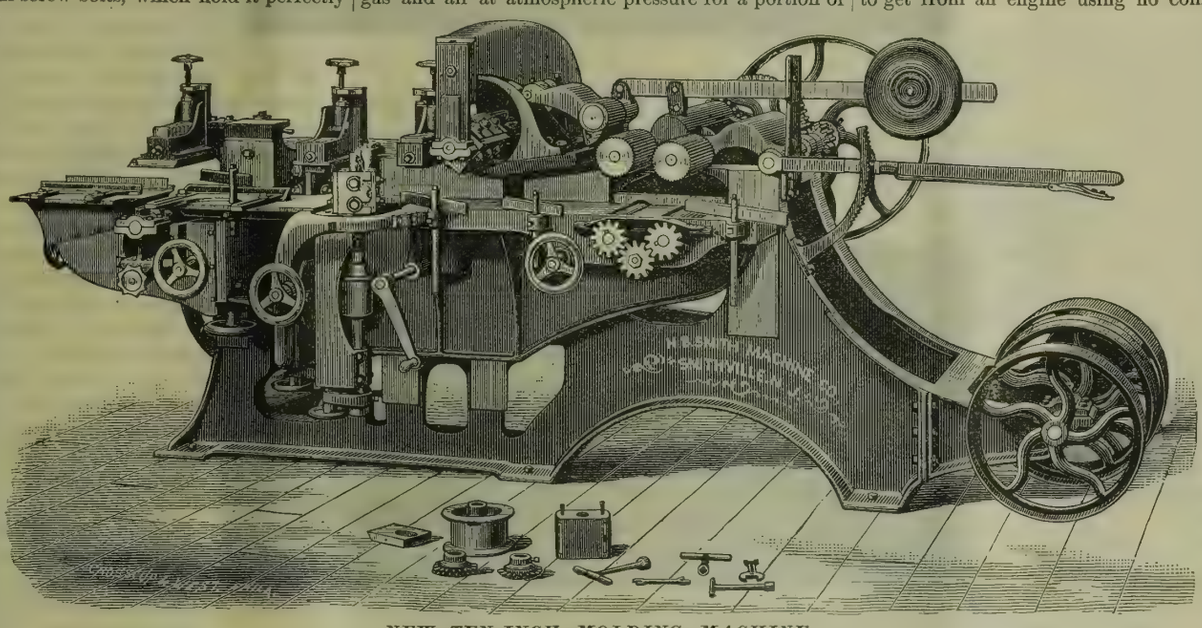
Smith & Howe are architects of the following buildings, now in course of erection: A brick court house at Woodstock, Shenandoah county, Va., to cost $15,000; a new brick church at Mount Gilead, Ohio, to cost $12,000; a row of brick buildings at Middletown, N. Y., to cost $35,000; a frame church in Negaunee, Mich., to cost $35,000; a frame church at Point Pleasant, N. Y., to cost $3,000; a frame dwelling at Elizabeth, N. J., to cost $5,000. Besides these, Messrs. Smith & Howe are altering a church at Terre Haute, Ind., at a cost of $10,000; and are preparing plans for a brick building for the New York Wood-Turning Company, at Harlem, to cost $20,000.

New Ten-Inch Molding Machine.

In the accompanying illustration we represent an improved and very effective molding machine made by the H. B. Smith Machine Co., of 925 Market street, Philadelphia, and which is adapted for all the various purposes to which molding machines are applied. It is intended especially to meet the wants of car-shops and large molding establishments. It is capable of cutting any kind of molding not exceeding 10 inches in width and 4 inches in depth. It will also dress on four sides flooring and sheathing, planing and matching up to 10 inches wide.

The table drops 12 inches for jointing door rails, etc., thus enabling the machine to plane on two sides timber not exceeding in dimensions 10×12 inches; the vertical screw for adjusting the table up and down is operated by a horizontal shaft in the front, geared so as to gain power, and is convenient of access. In addition to the support afforded by the single adjusting screw and long gibbed bearings, the table is firmly clamped to the frame near each end by two powerful screw-bolts, which hold it perfectly steady in any desired position.

A rigid outside bearing is provided and so arranged as to leave the upper head accessible from all points. This bearing is never disturbed while raising or lowering the table, and its position upon the shaft is not changed by adjustments of the upper headstock. Provision is made for adjusting this headstock from the front of the machine instead of the rear, as heretofore.



NEW TEN-INCH MOLDING MACHINE.

That portion of the table carrying the under cylinder, is vertically adjustable by means of a single screw, and the under cutter is also adjustable endwise, and is entirely accessible. The end beyond the under cutter is also adjustable. Each of the side heads are adjustable to or from the table by means of a single screw; they are also adjustable up and down, and may both be set at any desired angle.

The machine is provided with the necessary springs and three pressure bars, one of which is placed between the upper cylinder and outside vertical head. These pressure bars are arranged with adjustable sections, adapting them for holding moldings of any shape, or plain bars may be applied for surfacing only. All speeded shafts are of steel and run on boxes lined with the best Babbitt metal. The cutter heads are all of cast steel and slotted to carry four knives, except the under head, which is furnished with two slots only, unless otherwise ordered.

The feeding mechanism is of improved construction, consisting of two upper and two lower rolls, all driven, and are claimed to be the most powerful of any ever applied to a similar machine. The two upper rolls are fluted and heavily weighted. Smith's patent spur-feed rolls are also furnished.

Four rates of speed are provided for, being 22, 30 36 and 52 feet per minute. One set of plain knives is furnished with each head. One extra cap head and a complete set of wrenches are supplied. The fast and loose pulleys are 12 inches diameter, with 8 inches face, and should make 1,000 revolutions a minute. The machine weighs about 4,500 pounds.

To insure the proper condition of their machines, these manufacturers test all machinery before leaving the works, and guarantee the machine here described to be strictly as represented.

The Gas Engine.

The practical problem of the conversion of heat into mechanical work has been partially solved by the steam engine; but its efficiency was so low that it could not be considered as complete or final. Hot air in the past had been looked upon as a possible advance. Owing, however, to many futile attempts, it had long been deemed useless to look in that direction for better results. The great progress made in recent years with the gas engine, from the state of an interesting but troublesome toy to a practical, powerful rival of the steam engine, had shown that air might, after all, be the chief motive power of the future. Three distinct types of gas engines had been proposed: 1. An engine drawing into the cylinder gas and air at atmospheric pressure for a portion of its stroke, cutting off communication with the outer atmosphere, and immediately igniting the mixture, the piston being pushed forward by the pressure of the ignited gases during the remainder of its stroke. The in-stroke discharged the products of combustion. 2. An engine in which a mixture of gas and air was drawn into a pump, and was discharged by the return stroke into a reservoir in a state of compression. From the reservoir the mixture entered a cylinder, being ignited as it entered, and without rise in pressure, but simply increased in volume, and following the piston as it moved forward; the return stroke discharged the products of combustion. 3. An engine in which a mixture of gas and air was compressed or introduced under compression into a cylinder, or space at the end of a cylinder, and then ignited while the volume remained constant, and the pressure rose. Under this pressure the piston moved forward, and the return stroke discharged the exhaust.

Types 1 and 3 were explosion engines, the volume of the mixture remaining constant while the pressure increased. Type 2 was a gradual combustion engine, in which the pressure was constant, but the volume increased. Calculating the power to be obtained from each of these methods, supposing no loss of heat to the cylinder, it was found that an engine of type 1, using 100 heat units, would convert 21 units into mechanical work; in type 2, 36 units; and in type 3, 45 units. The great advantage of compression was clearly seen by the simple operation of compressing before heating, the last engine giving for the same expenditure of heat 2.1 times as much work as the first. Compression made it possible to obtain from heated air a great amount of work with but a small movement of piston, the smaller volume giving greater pressures, and thus rendering the power developed more mechanically available. Seeing the great difference produced between types 1 and 3 by the simple difference in the cycle of operation when there was no loss of heat through the sides of the cylinder, the question arose which engine in actual practice, with the cylinder kept cold by water, would come nearest this theory? In which of the engines would there be the smaller loss of heat? Comparing the two engines, with equal movements of piston, it was found that the compression engine had the advantage of a lower average temperature, and a greater amount of work done; also of less surface exposed to the flame, and consequently it lost less heat to the cylinder. Taking all the circumstances into consideration, it was certainly not over-estimating the advantage of the compression engine to say that it would, under practical conditions, give for a certain amount of heat, three times the work it was possible to get from an engine using no compression. The amount of gas consumed was as follows: Type 1—Lenoir, 95 cubic feet per horse-power per hour; Hugon, 85; type 2, Brayton, 50; type 3, Otto, 20. The Otto engine converted about 18 per cent of the heat used by it into work, while the Hugon engine only converted 3.9 p. c. Taking the loss of heat to the cylinder as given by the comparison of the adiabatic line of fall of temperature with the actual line of fall, as shown on the indicator diagram, it appeared much less than was really the case, as shown by the gas consumed by the engine. The maximum pressure produced was much less than would be expected from the amount of gas present—this was due to the limiting effect of chemical dissociation. In calculating the efficiency of the gas engine from its diagram, all previous observers had fallen into error, through neglecting the effects of dissociation, and, accordingly, their results were much too high. To account for this so-called sustained pressure, Mr. Otto had advanced the theory that inflammation was not complete when the maximum pressure was attained at the beginning of the stroke, but that by a peculiar arrangement of strata he had made it gradual, and continued the spread of the flame while the piston moved forward. Mr. Otto called it slow combustion. This designation seemed to the author to be erroneous; such an action should rather be called slow inflammation. It existed in the Otto engine, but only when it was working badly, and was attended with great loss of heat and power. This was proved by a diagram, and by certain considerations deduced from Bunsen and Mallard's experiments on the rates of propagation of flame through combustible mixtures.

From the considerations advanced in this paper, it would be seen that the cause of the comparative efficiency of the modern gas engines over the old Lenoir and Hugan type was to be summed up in the one word "compression." Without compression before ignition an engine could not be produced giving

power economically and with small bulk. The mixture used might be diluted, air might be introduced in front of gas and air, or an elaborate system of stratification might be adopted; but without compression no good effect would be produced. The gas engine was as yet in its infancy, and many long years of work were necessary before it could rank with the steam engine in capacity for all manner of uses. The time would come when factories, railways and ships would be driven by gas engines as efficient as any steam engine, and much safer and more economical of fuel. The steam engine converted so small an amount of the heat used by it into work, that, although it was the glory and the honor of the first half of this century, it should be a standing reproach to engineers and scientists of the present time, having constantly before them the researches of Mayer and Joule.

The Proportions of Riveted Joints.

We continue this month the subject of the proportioning of riveted joints in steam boilers. The formulas we give here, and have published in our two previous issues, show most of the proportions used for single riveted lap joints. Our next number will be devoted to double riveted joints, and we shall endeavor to call attention to some important points which are generally overlooked by boiler-makers.

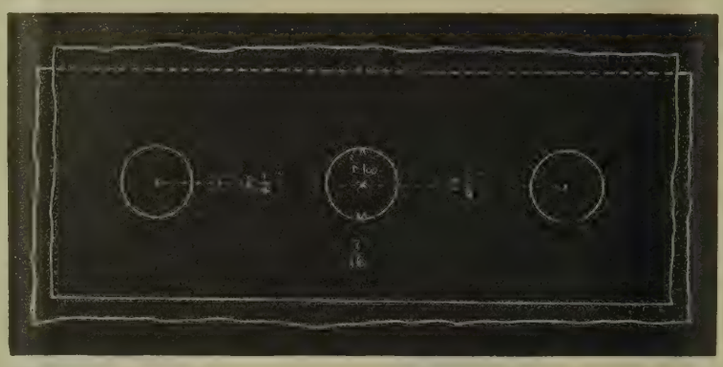


Fig. 10.

Fig. 10.—Plate $\frac{7}{16}$ inch thick; rivet holes, $\frac{7}{8}$ inch diameter; pitch of rivets, $2\frac{1}{4}$ inches. Strength of plate at joint $= \frac{2.25-.875}{2.25} = 61$ per cent of solid plate. Strength of rivets at joint $= \frac{.60132}{2.25\times.4375} = 61$ per cent of solid plate. A well proportioned joint.

Fig. 11.—Plate $\frac{1}{2}$ inch thick; rivet holes, $\frac{15}{16}$ inch diameter; pitch of rivets, $2\frac{1}{2}$ inches. Strength of plate at joint $= \frac{2.5-.9375}{2.5} = 62\frac{1}{2}$ per cent of solid plate. Strength of rivets at joint $= \frac{.69029}{2.5\times.5} = 55$ per cent of solid plate. Rivet about right, but pitch should be slightly lessened.

Fig. 11.

Fig. 12.—Plates $\frac{9}{16}$ and $\frac{5}{8}$ inch thick; rivet holes, $\frac{15}{16}$ diameter; pitch of rivets, $2\frac{1}{4}$ inches. Strength of plates at joint $= \frac{2.25-.9375}{2.25} = 58$ per cent solid plate. Strength of rivets at joint in $\frac{9}{16}$-inch plate $= \frac{.69029}{2.25\times.5625} = 54\frac{1}{2}$ per cent of solid plate. Strength of rivets at joint in $\frac{5}{8}$-inch plate $= \frac{.69029}{2.25\times.625} = 49$ per cent of solid plate. Rivets and pitch both too small, especially for the $\frac{5}{8}$-inch plate. See remarks under Fig. 3.

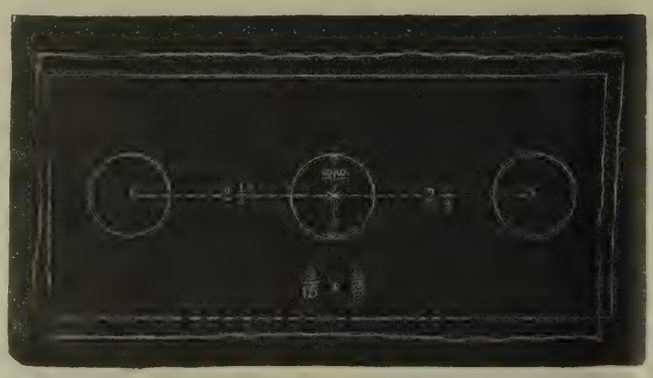


Fig. 12.

The Channel Tunnel.

Work on the tunnel between England and France, begun at a point near Dover, is steadily progressing. The depth of the shaft, which is a pit 9 or 10 feet in diameter, is about 160 feet, the bottom being about 100 feet below the level of low water. Very little water makes its way through the crevices between the planks with which the shaft is lined, the moisture trickling down all coming from near the surface. At the bottom and within the tunnel, apparently throughout its length, the hard, homogeneous gray chalk was found to be quite dry, and no signs appear even of such inconsiderable springs as are tapped in the fissures of the corresponding strata on the French coast at Sangatte. The tunnel has been driven beneath the seaward base of Shakespeare's Cliff—that is, in an easterly direction, towards the head of the Admiralty pier, for a distance of over 1,100 yards, or nearly two-thirds of a mile, with a slope downward of 1 foot in 80, the furthest point where the boring is now going on being about 140 feet below the level of the sea. The shaft is approximately two miles from the head of the Admiralty Pier, and when the tunnel has been carried about half the distance or a mile from the shaft, a bend will be made towards the French shore. At the eastern end of the tunnel through the cliff, perhaps three-quarters of a mile from the shaft hitherto spoken of, another shaft, called No. 3, is being sunk. Here, when the works have made a little more progress, will be the engines for pumping the air into the tunnel, and for pumping out the water which always finds its way into tunnels of any great length. This point, it will be observed, is commanded by the heavy gun at the head of the Admiralty Pier and by the guns on the land fortifications. At the end of the tunnel a Beaumont cutting machine is at work. The length of this machine from the borer to the tail end is about 33 feet. Its work is done by the cutting action of short steel cutters fixed in two revolving arms, seven cutters in each, the upper portion of the frame in which the borer is fixed moving forward five-16ths of an inch with every complete revolution of the cutters. In this way a thin paring from the whole face of the chalk in front is cut away with every turn of the borer, and a circular tunnel is formed having a diameter of 7 feet. A man in front shovels the crumbled débris into small buckets, which, traveling on an endless band, shoot the dirt into a "skip" tended by another man. The skip, when filled, is run along a tramway to the mouth of the shaft. At present these trolleys, each holding about one-third of a cubic yard, are drawn by men, but before long it is expected that small compressed air engines will be used for traction. The rate of progress made with the machine is about 100 yards per week, but Colonel Beaumont anticipates no difficulty in making the machine cut its way at the rate of three-eighths of an inch per revolution, and getting five revolutions per minute, which would give a rate of advance of two inches per minute.

A very important question has been raised with regard to the supply of compressed air. Carried in 4-inch pipes, it now reaches the machine with a pressure of about 20 pounds, the pressure at the compressor at the shaft mouth being from 30 to 35 pounds; but by increasing the diameter of the supply-pipe to 8 inches the loss of working value by friction would be greatly diminished, if not rendered inappreciable. The liberated and expanded air given off by the machine serves to ventilate the tunnel sufficiently at present for the workers, and one advantage which it is held would be gained by the use of compressed air engines, is that the pure sea air compressed at the surface would be given off, when it had done its work in driving the engine, in more than sufficient quantity to supply the fresh oxygen required by the travelers in a train. Each engine, being charged with 1,200 cubic feet of air at a pressure of 70 atmospheres, or the equivalent of over 80,000 cubic feet of free air, would, argues the inventor, while traveling at the rate of 30 miles an hour, and giving out 4,000 cubic feet per mile, supply 2,000 cubic feet of fresh air per minute.

The work in the tunnel is carried on by the light of Swan's incandescent lamps, the electricity being generated by Siemens' machines.

Flow of Water in Pipes.

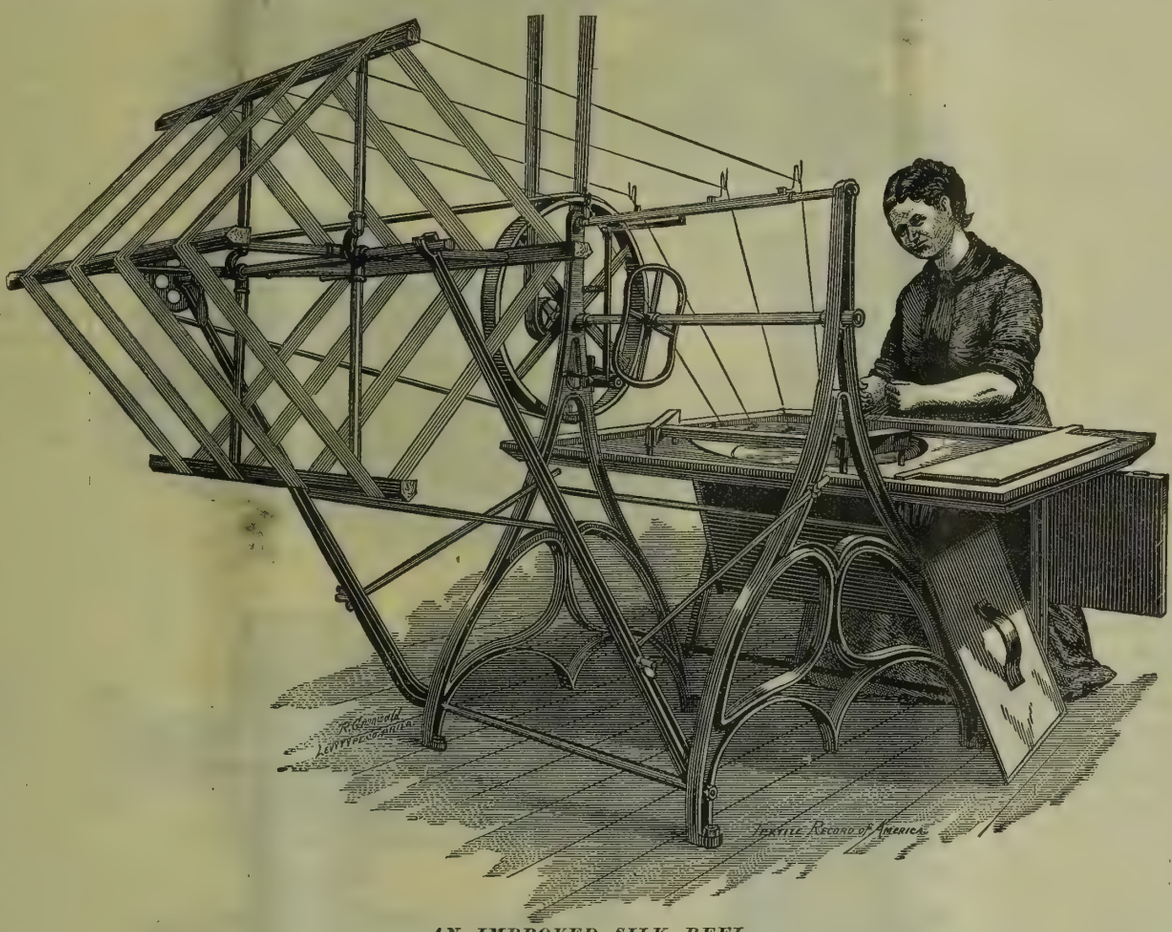
Engineering reports briefly some experiments made by W. F. Stanley, in the endeavor to discover the mode of flow of water in pipes. His aim was to show that "liquids move by rolling contact upon or past the resisting surfaces of the pipe, and not by a sliding, gliding or shearing action." This question of the movement of the particles of flowing water, both in open channels and in closed pipes, is of the utmost importance in the determination of the formulas for flow. The true law of frictional resistance has not yet been discovered, and every formula which has been framed from experimental researches under one set of conditions, has failed when applied to other conditions. We believe that this is due to imperfect knowledge of the internal movement of the liquid particles, and consequently false assumptions with regard to the effect of irregularities in the wet surface of the channel. Experiments in the direction in which Mr. Stanley

seems to be working, will be of great value if the experimeter will carefully observe the facts developed, and will not begin to theorize too soon and endeavor to make the facts fit his theories.

A New Silk Reel.

At the stated meeting of the Franklin Institute, Philadelphia, on Wednesday, February 15, 1882, the Secretary, Dr. William H. Wahl, gave the following explanation of the improved iron-frame silk reel lately constructed for the Women's Silk Culture Association:

A year or so ago the association, after considerable trouble, succeeded in getting a pattern of the reels which were said to be in use in France and Italy—a heavy, clumsy affair, all of wood, which stood upon four legs, like a table. After it had been in use a little while, it warped, and became so troublesome to use that it occurred to some of the members of the Advisory Board to have a mechanical reel constructed of metal, which would work more accurately, and represent in an improved form the best ideas we had upon the subject. This was finally decided upon, and after some consultation, the speaker was requested to secure the services of an expert machinist to construct such a reel. Mr. Hugo Bilgram, a member of the Institute, was requested to undertake the work; and the result of his intelligent comprehension of the subject is seen in the admirable, light, easy and rapid running reel shown in the cut, for the use of which we owe thanks to the *Textile Record*. It is constructed entirely of metal, is very light and compact, and can be closed together in very compact form when not in use, or when it is to be removed from place to place. While there is no radical departure in its construction from that of the old forms of the hand reel, the new machine appears to embody every desirable feature that a hand reel should have.



AN IMPROVED SILK REEL.

The silk is wound upon the reel, the motion being communicated to the machine by hand. The driving wheel is grooved, and motion is transmitted to a smaller grooved pulley on the shaft of the reel, the proportions between the driving and driven pulley being as 4 to 1. The traverse which effects the crossing of the strands on the reel is given by an open cam on the driving shaft. This engages with a bell-crank lever, connected with a brass sleeve upon a cross-bar above, which slides back and forth with the motions of the lever arm. The guides through which the silk threads pass to be wound on the reel, are attached to this sleeve, and they are thus given the required crossing.

The reel works with great accuracy, and without jar or lost motion, and it has proved to be most satisfactory as a first effort to construct such a machine in metal.

The skilled reeler employed by the association is enabled to reel more than double the quantity of silk upon this than upon the old wooden reel, a result highly gratifying to the association, and one that has a very important bearing on the question of the profitable reeling of silk by hand in the United States.

Plumbago.

Apropos of our answer to a query concerning plumbago, or black lead, in our March number, we reproduce the following points of interest relating to it: A piece of black lead appears to have been named on much the same principle as that followed in naming the Speaker of the House of Commons. The Speaker is a man who does *not* speak; the black lead is a substance which contains *no* lead. It is true that a piece of black lead presents characters which, at first sight, are strongly suggestive of a metal; but it is easily shown that these characters are only superficial and delusive. If we split open a lead pencil, and extract the thin rod which forms the axis of the cedar cylinder, we obtain a body which resembles a metal, inasmuch as it possesses a dark iron-gray or lead color, coupled with exactly that kind of luster which we generally regard as characteristic of metallic bodies. The surface of a compact piece of metal always presents a peculiar brilliancy, due to the fact that much of the light which falls upon the surface is thrown back instead of passing into or through the substance; in other words, the light incident upon the surface is neither absorbed nor transmitted to any considerable extent, but is almost wholly reflected or scattered. Now, there are but very few substances, except metals, which possess such a condition of surface as to produce this metallic sheen. Iodine is one of these non-metallic bodies that look like a metal, and black lead is another. It is mainly in consequence of the metal-like luster of black lead that the material is so largely employed as a polishing agent. When the housemaid rubs the powdered substance upon the cast-iron grate or fender, she produces a reflecting surface which has a metallic appearance; and, at the same time, the thin coating which is thus applied serves to protect the underlying metal from rust. In like manner, though for a different reason, black lead is extensively used for polishing certain kinds of gunpowder, especially the coarse-grained powder employed for blasting in mining operations. The powder is placed, with the finely-divided black lead, in revolving barrels, and the grains receive a glaze or varnish which protects them from absorption of moisture. Any conclusion as to the metallic nature of black lead which may have been suggested by the luster and color of the mineral, is likely to be rudely shaken on noting its specific gravity. By merely poising a piece of black lead in the hand, we may observe how light it is, compared with ordinary metallic bodies. In fact, the specific gravity of black lead is but little above 2—that is to say, the mineral does not weigh much more than twice its own bulk of water. Advantage is sometimes taken of this comparative lightness in dressing black lead for the market. It frequently happens that a rock may contain scales of plumbago disseminated throughout its substance, so as to form what has been called "black lead ore." In such a case it is possible to separate the two substances by crushing or stamping the ore, and allowing the fine fragments mixed with water to flow over a mechanical contrivance, in which the light scales of black lead and the heavier stony particles roughly sort themselves by virtue of this difference of density. It is scarcely conceivable that these light scales of plumbago can contain a metal so heavy as lead.

Oiling Belts.—Care should be taken that belts be kept soft and pliable; and experience has taught us that the best article for this purpose for leather belting, is good castor oil. It softens, and at the same time removes all dirt and scales from the surface of the belt, thereby causing it to adhere the more closely to the pulley. Resin is sometimes used to prevent belts from slipping. While this may have the desired effect for the time, in the end it causes the very thing which the purpose is to prevent, by stiffening and hardening the belt, and causing a scale to gather on the face of the belt, thereby preventing the surface of the belt proper to come in contact with the pulley. After such scale has gathered on the belt by the use of resin, or from any other cause, castor oil will readily remove it. Belts, to give the best results, should have good attention.

Dynamo-Electric Machines.

We have several times alluded, in our references to the subject of electric lighting, to the important part played in the practical solution of this interesting problem, by the so-called dynamo-electric machine, by which a current of electricity of great energy is produced by the conversion of mechanical energy, derived from whatever source (a steam engine, waterfall, etc.,) into electric force. The improvement of this class of machines has done away entirely with the old, cumbersome and inconvenient chemical battery upon which we were formerly dependent for our supplies of electricity, and which, because of its troublesome and expensive character, had, until lately confined the electric light to the laboratory and the lecture-room, and placed the general introduction of electricity for technical uses entirely out of the question.

We now gladly embrace the opportunity afforded us by the publishers of the supplement to "Knight's Mechanical Dictionary" in furnishing us with an excellent illustration showing the several more prominent forms of the dynamo-electric machine, to lay before our readers a brief statement of their construction and action; in doing which we adhere as closely as possible to the text of the supplement, that nothing shall be wanting in accuracy of definition.

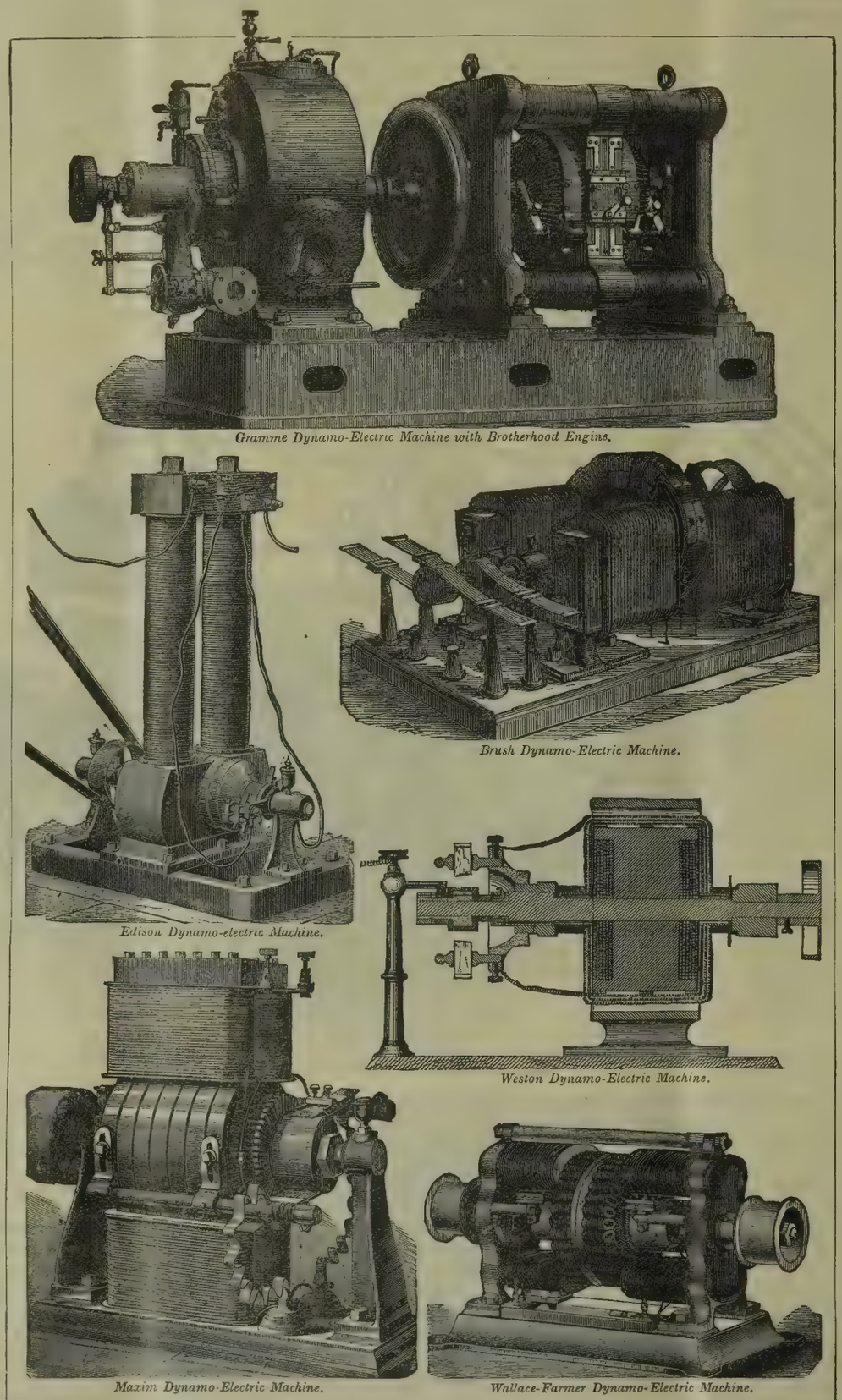
Sawyer defines a dynamo-electric machine as an electro-voltaic generator, whose magnetic field is derived from an electro-magnet, in contradistinction to a magneto-electric generator whose magnetic field is derived from a permanent magnet. Knight defines it to be a machine for translating motion into electricity, in which the magnetic field in which the armature rotates is formed by electro-magnets having their coils connected in a circuit with the coils of the armature and the main line, whereby, upon starting the machine with a minimum of magnetism in the cores of the field magnets, an inter-reacting cumulative action takes place, the initial magnetism creating an initial current in the armature, which, flowing around the field magnets, increases their force, in turn reacting on the armature coils, and so on until the maximum current is produced when the field cores attain saturation.

On the authority of the London *Engineer*, Knight gives the credit of having first devised and constructed a dynamo-electric machine, or "accumulative generator," to Soren Hjorth, a Danish inventor, whose English patent bears date of October 14, 1854. This fact we record simply in passing as a matter of historical interest. Following this invention came others of Siemens & Halske and Wilde, which attracted much attention.

In 1860, Dr. Pacinotti, of Pisa, devised the first machine of this class for the production of an electric current constant in direction and intensity, which Knight describes under the name of an "electro-magnetic ring machine. Up to the period of the invention of the Pacinotti machine, the armature had its magnetism reversed as it rotated, involving a waste and loss of power. The Italian inventor devised the idea of the ring, and rotating the ring between the poles of a magnet in such a way that there should be no reverse of poles, but merely the traveling of the poles around in the ring. This ring was surrounded with wires from which the induced current was taken. The idea involved was embraced in the Gramme machine, and accepted by electricians only after much dispute and opposition. Gramme appears, however, to have been an independent and original inventor.

The machine of this inventor, which was first brought out in 1873, was so far superior to those which had preceded it, that it may be considered as having given the impetus that has resulted in the great improvement in this class of machines that has since taken place. The Gramme machine consists of a permanent field magnet, between the poles of which are armatures of peculiar construction, formed by coiling around a soft iron core a wire of copper, forming the entire coil into an endless bobbin, in the shape of a cylinder or ring, the wire being provided at suitable intervals with metallic rods or conductors for allowing the proper exit of the electric current generated. These rods extend axially of the core, and at their ends on diametrically opposite sides of said axis connect with two rolling commutators which lead to line.

In the earlier form of the Gramme machine the inventor mounted three rings upon one spindle, each revolving within the magnetic field of two very large rectangular electro-magnets. One of these rings supplied the current by which all the electro-magnets were excited, and the others were united so as to produce the external or useful current. But in the newer and far more powerful machines this arrangement is superseded, there being but one induction ring, and the coils of the electro-magnet are included in the circuit, the whole of the current traversing them. In the



Gramme Dynamo-Electric Machine with Brotherhood Engine.

Brush Dynamo-Electric Machine.

Edison Dynamo-electric Machine.

Weston Dynamo-Electric Machine.

Maxim Dynamo-Electric Machine.

Wallace-Farmer Dynamo-Electric Machine.

DYNAMO-ELECTRIC MACHINES.

modern Gramme machine, such as is used for illumination purposes, the ring is mounted on a horizontal shaft which is revolved at a speed of 900 revolutions per minute within the electric field of the four horizontal electro-magnets shown in the plate. The two upper magnets are united to a common pole piece, which embraces about three-eighths of the circumference of the ring, and the two lower magnets are connected to a similar pole piece opposite in polarity to that attached to the upper magnets.

The Brush machine consists of two large horse-shoe electro-magnets placed with their similar poles facing each other, the armature revolving between them. The currents are generated in the coils of copper wire wound upon the armature. The coils are eight in number, opposite ones being connected end to end, and their terminals carried to the commutator, which consists of segments of brass, secured to a ring of non-conducting material carried on the shaft. The commutator is so arranged that at any instant three pairs of coils are interposed in the circuit of the machine. The current is conveyed from the commutator by means of brushes made of strips of hard brass joined together at their outer ends and connected with a binding screw on the base.

The Wallace-Farmer machine has a magnetic field produced by two electro-magnets, with the poles of opposite character facing each other. Between the arms of the magnets, and passing through the uprights supporting them, is the shaft, carrying at its center the rotating armature. The latter consists of a disk of cast iron, near the periphery of which, and at right angles to either face, are iron cores wound with insulated wire, thus constituting a double series of coils. These armature coils being connected end to end, the loops so formed are connected in the same manner on to a commutator of the same construction as that of the Gramme. As the armature rotates the cores pass between the opposed north and south poles of the field magnets, and the current generated depends on the change of the polarity of the cores.

In the Weston machine the rotating magnet is inclosed in stationary coils in an annular stationary iron shell. The coils are wound in cylindrical form upon a skeleton frame of non-magnetic material, within which the electro-magnet rotates. The latter is mounted upon a neutral axis, and its periphery moves in close proximity to the surrounding coil. Apertures at the end of the cylinder admit air into the space within the coils. The skeleton frame is divided into eight segments, and each of the three coils traverses the entire exterior of the skeleton frame, extending across the ends of the cylinder, from the segment on one side to the segment diametrically opposite, and the free ends of the coil are respectively connected with two stationary brushes bearing upon directly opposite sides of the cylindrical commutator.

In a late patent of Weston, the skeleton core is rendered discontinuous by a series of deep transverse grooves, and by a longitudinal slit from end to end of the armature, and currents of air are passed through to counteract the heat produced by the resistance of the current, and which might destroy the insulation and does increase the resistance.

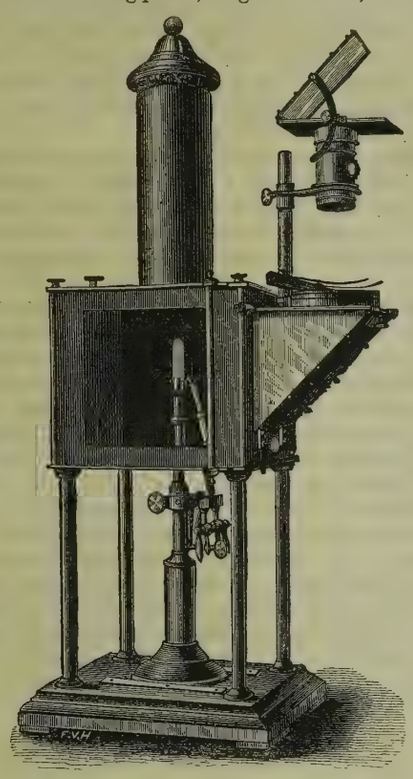
Maxim's dynamo-electric machine has an armature of soft iron rings with the wire wound parallel with the axis, both plates and wires being so arranged that a free circulation of air is admitted through the armature to prevent dangerous heating. The commutator is large and heavy, and the sections curved in a right and left spiral, so as to avoid any break in the current.

The Edison magneto-electric machine has a revolving armature, a cylinder of wood with two iron heads, and around the cylinder and between the heads fine iron wire is wound. At the ends of the cylinder, outside the iron heads, are disks of hard rubber, and the wires forming the induction helix are wound lengthwise of the cylinder into notches in the edges of the disk.

The Vertical Lantern.

The stereopticon has been so much improved during the past few years, by the perfecting of its parts and by providing it with new attachments, that it is now available for almost any kind of illustration; and because of its very general utility, it has become an indispensable part of the working apparatus of the school and lecture-room. It would take many columns to describe even the more prominent of the recent improvements of the stereopticon, and we confine ourselves here to a description of one of the most ingenious and useful of the recent attachments that have been devised for it, and which is known as the "vertical attachment."

The utility of this device will appear from the following: It is very often desirable to project such phenomena as the ripples on the surface of water; the curious figures made by drops of oil falling on the surface of water; the movement of a horizontal galvanometer needle; acoustic figures formed by sound on vibrating plates; magnetic curves; or chemical reactions, such as precipitations, color changes, and the like. Such phenomena as these cannot be shown in the ordinary form of apparatus for projection. The old and very crude way sometimes adopted was to turn the lantern up so that it rested upon its back. This, however, was not only a very awkward and inconvenient method, but it endangered the condensing lenses of the lantern from the great heat immediately under them. The necessity of providing a more convenient means of meeting this want attracted to the solution of the problem several eminent men of science, and the result of their efforts to solve it is found in the device which we illustrate herewith, and which is commonly known as the "vertical lantern."



The Vertical Lantern.

It consists, in a general way, of a plane mirror inclined at an angle of 45°, and when so placed that the beam of light from the lantern falls upon it, it is reflected perpendicularly upwards upon a lens that converges the light when it passes through the objective above it, and falls upon a second mirror, which is so mounted as to allow of reflection in any direction.

The illustration herewith given represents a very excellent form of this useful device, manufactured by Messrs. James W. Queen & Co., of Philadelphia. The lantern shown combines the vertical and horizontal positions. The brass body, 11 inches long, 9 inches high and 8 inches wide, is rigidly held together by thumb-screws on top, and is supported by four polished brass pillars at an elevation of 11½ inches, so as to fit it for the reception of the electric regulator or the oxy-hydrogen jet; it is surmounted by a tall chimney to carry off the heat; the doors are swung on steel points. To the front inside is attached the collecting lens of the condenser; the condensing lens itself is set in the collar on the flap or door hinged on the outside; this collar supports the bar carrying the object glass and Foucault mirror, and all may be rotated around the optical axis of the instrument. When this instrument is to be used as a vertical lantern, this flap is raised to a horizontal position and is supported by the brass prism inclosing the reflector.

With this apparatus, which can be converted from the usual horizontal lantern to the vertical form in a few minutes, the convenience of the stereopticon is very greatly enhanced, and the range of its applications for illustration vastly increased.

How Blue Prints are Made.

The *Locomotive* gives the following method of copying tracings by the blue print process:

The materials required are: 1. A board a little larger than the tracing to be be copied. The drawing-board on which the drawing and tracing are made can always be used. 2. Two or three thicknesses of flannel or other soft white cloth, which is to be smoothly tacked to the board to form a good smooth surface, on which to lay the sensitized paper and tracing while printing. 3. A plate of common double-thick window glass of good quality, slightly larger than the tracing which it is wished to copy. The function of the glass is to keep the tracing and sensitized paper closely and smoothly pressed together while printing. 4. The chemicals for sensitizing the paper. These consist simply of equal parts, by weight, of citrate of iron and ammonia, and red prussiate of potash. These can be obtained at any drug store. 5. A stone or yellow glass bottle to keep the solution of the chemicals in. If there is but little copying to do, an ordinary glass bottle will answer, and the solution made fresh whenever it is needed for immediate use. 6. A shallow earthen dish in which to place the solution when using it. A common dinner plate is as good as anything for this purpose. 7. A brush—a soft paste brush, about 4 inches wide, is the best thing we know of. 8. Plenty of cold water in which to wash the copies after they have been exposed to the sunlight. The outlet of an ordinary sink may be closed by placing a piece of paper over it with a weight on top to keep the paper down, and the sink filled with water, if the sink is large enough to lay the copy in. If it is not, it would be better to make a water-tight box about 5 or 6 inches deep, and 6 inches wider and longer than the drawing to be copied. 9. A good quality of white book paper.

Dissolve the chemicals in cold water in the following proportions: 1 ounce of citrate of iron and ammonia, 1 ounce of red prussiate of potash, and 8 ounces of water. They may all be put into a bottle together and shaken up. Ten minutes will suffice to dissolve them.

Lay a sheet of the paper to be sensitized on a smooth table or board, pour a little of the solution into the earthen dish or plate, and apply a good even coating of it to the paper with the brush; then tack the paper to a board by two adjacent corners, and set it in a dark place to dry; one hour is sufficient for the drying; then place its sensitized side up on the board on which you have smoothly tacked the white flannel cloth, lay your tracing which you wish to copy on top of it; on top of all lay the glass plate, being careful that paper and tracing are both smooth and in perfect contact with each other, and lay the whole thing out in the sunlight. Between 11 and 2 o'clock in the summer time, on a clear day, from 6 to 10 minutes will be sufficiently long to expose it

at other seasons a longer time will be required. If your location does not admit of direct sunlight, the printing may be done in the shade, or even on a cloudy day, but from one to two hours and a half will be required for exposure. A little experience will soon enable any one to judge of the proper time for exposure on different days. After exposure, place your print in the sink or trough of water before mentioned, and wash thoroughly, letting it soak from 3 to 5 minutes. Upon immersion in the water, the drawing, hardly visible before, will appear in clear white lines on a dark blue ground. After washing, tack up against the wall, or other convenient place, by the corners to dry. This finishes the operation, which is very simple throughout.

The Best Gas for the Gas Engine.—In view of the growing introduction of this convenient form of motor, it is a matter of very general interest to know the kind of gas best adapted to yield the highest results with it. In a former article we indicated, in a general way, that the richer the gas the higher would be the duty obtained from it. This conclusion we find is now verified by the results of some very careful investigations lately made by Mr. Charles Hunt, who communicates his results to the Society of Gas Engineers. We give in what follows a brief *résumé* of his results:

The chief object of Mr. Hunt's experiments was to determine the relative values of different qualities of illuminating gas when used in gas engines. Before commencing the trials, the engine (a 12 horse-power Otto) was thoroughly cleaned and the bearings adjusted and lubricated. The diagrams were taken with a Richards indicator, six diagrams being taken for each quality of gas, and as they were repeated three times, the summary gives the average of 18 indications. The engine was weighted with its maximum load, and the actual horse-power was obtained by applying a strap brake to one fly wheel, so that the actual loss by friction of the engine itself was also ascertained. The gas used in each case was the absolute product of the coal or cannel distilled and purified in the usual way, without any admixture of air; and the burners used for photometrical purposes were a No. 1 "London" argand for gases up to 18 candles, and for higher qualities a stealite bat's-wing. The precautions taken to insure accurate results were apparently all that could be demanded. The gas was in all cases supplied under uniform pressure, and it was noted that the speed of the engine depended entirely upon the extent of the opening of the gas valve.

A number of interesting results were obtained. Mr. Hunt found, for example, that the loss between indicated and actual power showed that about 25 per cent was absorbed in the friction of the moving parts —an amount which compares favorably with steam engines. The most interesting figures in the elaborate and reliable tables given by Mr. Hunt are, however, those which show the quantity of gas of different qualities consumed per horse-power per hour, which we give below:

Candle-power.	Gas—cubic feet.	Actual horse-power.
11.96	40.08	14.49
15.	32.55	14.50
17.20	30.64	14.36
22.85	23.56	14.60
26.	21.55	15.03
29.14	20.34	14.35

These figures show that about half the quantity of a rich gas suffices to yield a horse-power as compared with common 12-candle gas. In fact, the rule may be said to hold good, that the lower the illuminating power of the gas the greater the quantity necessary to yield a horse-power. In many cases, therefore, it would appear that there will be considerable gain to users of gas engines, by simply enriching a common coal gas with one of the cheap volatile hydro-carbons, such as gasoline.

Mr. Hunt appears to have been the first to investigate this very interesting subject, and we are specially gratified to find that the results of his investigations tally so closely with the general opinions we expressed on the subject in this journal some months ago.

The Effect of Compression on Solids in a state of fine division, has lately been made the subject of an investigation by a German savant, who announces some very curious results. His experiments were made with solids in the condition of a fine powder, and the same were submitted to pressures varying from 2,000 to 7,000 atmospheres, or about 7,000 kilograms per square centimeter, in a steel mold.

He found when lead filings were subjected to a pressure of 2,000 atmospheres, that the material was transformed into a solid block, which showed no evidence of granular texture under the microscope, and which had a density of 11.5, while that of the ordinary metal is only 11.3. At 5,000 atmospheres, the curious fact is noted that the lead became liquefied and flowed out through the interstices of the apparatus.

The powders of zinc and bismuth, treated in a similar manner, gave solid masses having a crystalline texture. The pressures to which they were subjected were from 5,000 to 6,000 atmospheres. At the last named pressure, it is noted that zinc and tin appeared to liquefy.

A number of powdered salts solidified under high pressures, and formed a transparent mass, showing that the molecules had become united. Some of the hydrated salts, like sodic sulphate, are completely liquefied at high pressures. Certain organic substances, such as the fatty acids, starch, etc., change their texture and appearance, undergoing a considerable change in appearance, in consequence of the considerable molecular change they undergo.

These experiments have considerable interest, in showing that where sufficient pressure is applied, pulverulent substances may readily be converted into solid masses by the union of their molecules. They are suggestive, also, of practical application, for there are doubtless many processes in the arts and manufactures where the solidification of pulverulent materials by this simple process would be desirable.

Science of Value to all Men.—M. Quartrefages, in an address before the French Association for the Advancement of Science, at Bordeaux, thus emphasizes the value of scientific knowledge, not only for those who make it a specialty, but for all practical and intelligent men:

"All men cannot be expected to enlist under the banner of professional science. But all may, and must, acquire scientific notions, sufficient at least to understand the utility of the intervention of special men, and to be able to judge when that intervention becomes necessary. Science is nowadays omnipresent, and tends more and more to become the sovereign of the world. What industry is there that does not want the help of the engineers, and would remain content with the progress already accomplished? What class of manufacturers would decline the help of chemistry? What medical practitioner, worthy of that name, would consent to forsake physiology, that complex science, the offspring of chemistry, and would do without natural philosophy any more than anatomy? What intelligent agriculturist does not understand that the problems of culture and production are essentially questions belonging to zoölogy, botany, geology and chemistry? And in this great city, one of the queens of universal commerce, what merchant would deny the importance of geography?

"Science is as indispensable to the military man as it is to the manufacturer, the medical practitioner, and the agriculturist. I am not going to undervalue the share that, in war, falls to inspiration and gallantry. But inspiration must be enlightened by study, and courage must be aided by weapons equal in efficiency and power to those of the enemy. No more than the agriculturist and the manufacturer can the officer master all the sciences, the help of which is necessary to his profession. He cannot be expected to solve by himself all the problems raised by his single art. It is essential that he should first ascertain these problems, and then appeal to scientific men, pointing out to them the application he wants. Let us, therefore, stir up the intellect of all men. Surely we may hope to bring to light many treasures, which, for want of the opportunities which it will be our object to create, might remain buried in the darkness of ignorance."

Blasting with Lime.—A recent paper read before the British Iron and Steel Association by Mr. Moseley, gives an account of an ingenious method of breaking down coal in the mine without the use of gunpowder or other explosive, and which consequently does away with the danger of igniting fire-damp, and other dangers attending the methods at present in vogue. Mr. Moseley employs, as a substitute for gunpowder, the expansive force exerted by quicklime and water.

The operation is as follows: The quicklime obtained from mountain limestone is finely ground and consolidated by a hydraulic pressure of 40 tons into cartridges of suitable size for the purpose. These cartridges have a groove along the side. They are packed in air-tight boxes to protect them from dampness, and conveyed to the mine for use. The shot holes are drilled in the coal by means of a light boring machine, and an iron tube having an external groove or channel, and provided also with perforations, into the bore hole. The tube is enclosed in a bag of calico, covering the perforations and one end, and has a tap communicating by means of flexible tubing with a force pump at the other. The cartridges are then inserted in the hole and rammed tightly to insure their filling the hole. After closing the hole by tamping, as is the practice when gunpowder is used, a quantity of water about equal in volume to that of the lime is forced in. The water escapes through the perforations of the iron pipe, flowing towards the tamping through the lime and saturating it. The tap is then closed to prevent the escape of the steam generated, and the flexible tube connected with the pump is disconnected. By the combined action of the steam generated and by the expansion of the lime in slaking, the coal is broken clean from the roof in from 10 to 15 minutes, and falls in large masses, making very little small coal. The process is said to be in successful use in some of the Derbyshire collieries.

Flameless Combustion.—At the *soirée* of the Society of Chemical Industry at Owens College, a new theory of combustion was practically illustrated by Mr. Thomas Fletcher, of Warrington. Mr. Jacob Reese, the inventor of the Reese fusing disc, has stated his belief that if it were possible to produce combustion without flame, the temperature and duty obtained from any fuel would be enormously increased. It has remained for Mr. Fletcher to not only prove the possibility of flameless combustion in more than one form, but also to demonstrate practically the enormously high temperatures which can be obtained by this means. Taking a ball of iron wire about three pounds in weight, Mr. Fletcher placed it on a slab of fire-clay, and directing a blow-pipe flame on it for a few seconds, he suddenly blew the flame out. The temperature increased so rapidly that in a few seconds the wrought iron fused and ran into drops, and this temperature was steadily maintained. The room was darkened, but the closest examination did not show a trace of flame, although the fact that the gas was burning was proved by repeatedly relighting and extinguishing it. The same experiment was

repeated in another form by directing the flameless heat into a small fire-clay chamber, in which a refractory clay crucible, made specially for nickel melting, was partially fused and worked into a ball like soft putty, the sides of the fire-clay chamber being at the same time fused. The heat was so tremendous that the blow-pipe laboratory, which was given up to Mr. Fletcher for the evening, was much too hot to be agreeable, in spite of open windows and ventilators. How far this discovery can be utilized remains to be seen; but it would appear that the presence of flame, usually considered to be a sign of combustion, is really an indication of imperfect results, and the best duty is to be obtained only when flame is totally absent. It is certain that such temperatures as obtained by Mr. Fletcher without flame have never previously been obtained with the fuel used, which was nothing more than a small gas supply for a ¼-inch pipe, assisted by an air blast.

Siemens' Electric Smelting Pot.—In this smelting apparatus, the intense heat of the voltaic arc is utilized. The two poles, formed of thick rods of carbon, enter the crucible of graphite or refractory clay through suitable openings provided in the bottom and the cover, and the body of the crucible itself is thickly surrounded with some good non-conducting envelope. The positive pole, at which the intense heat is developed, is introduced at the bottom of the crucible and is covered with the material to be smelted. The negative pole enters through the lid or cover, and by means of a self-regulating device, such as is used with the electric lamps, is kept at the same distance from the metallic surface.

Where it is found to be advantageous, this negative pole may be made of copper or platinum, and hollow, so that it may be kept comparatively cool by a stream of cold water circulating within it. The spark, however, between it and the positive pole develops sufficient heat to readily fuse the most refractory metals, such as steel, platinum or iridium.

With the use of a dynamo-electric machine, requiring seven horse-power to run it, and which can readily be set up in a laboratory, lecture-room or workshop, several pounds of steel may be fused in the space of a quarter of an hour. Every pound of coal consumed in the steam boiler from which the power of the dynamo is ultimately derived, has been found sufficient to smelt one pound of cast steel, In similar manner, a number of other difficultly fusible metals and metallic mixtures may be readily smelted in this convenient laboratory apparatus.

While it is difficult in a smelting furnace to obtain a temperature above 3000° or 4000° Fah., it is affirmed that with this apparatus the actual attainable temperature is unlimited; and it is suggested that with its aid it will be possible to carry out many interesting and important experiments which have hitherto been impossible, because they required such enormous and heretofore utterly unapproachable temperatures. One highly important series of experiments which may be prepared with its aid, is that of determining the question of the possible dissociation of our so-called chemical elements at enormously high temperatures, which is held to be probable by many investigators. It is highly probable that with its aid many new and important facts will be discovered.

Boracic Acid as a Preservative of Foods.—In describing a recent process for preserving food, we ventured to express some doubt as to the wholesomeness of boracic acid, and the compound of this acid, called by its inventor (Mr. Barff) "boro-glyceride," which have been of late much lauded as preservatives of food. We know nothing from personal observation on the subject, but, while the efficiency of boracic acid and its compounds for this purpose is undoubted, it is a matter of the utmost importance to determine beyond doubt the question of its action on the human system when taken in small quantities for a prolonged period, as would be the case where food products preserved by its use were consumed for a lengthened time. Until this fact can be ascertained, it would be hazardous to endorse the use of this preservative for the purpose simply because of its excellence as an antiseptic.

A writer in the *British Medical Journal* takes substantially the same view of the subject. He adds, however, direct testimony from personal observation, that the continuous use of small quantities of boracic acid is hurtful. The case in question is not made out so clearly as to be beyond doubt, but it is made so probable that caution in the use of this substance as a food preservative would seem to be very necessary, until its wholesomeness shall be established beyond doubt.

The Center of Population in the United States in 1790 was 22 miles from Baltimore, and, according to the statistics of successive censuses, it has moved westward at the average rate of 51 miles every decade, never deviating to the extent of a degree North or South of the 39th parallel of latitude. The greatest progress was between the years 1850–60, when it traveled 81 miles from a point in Virginia to 20 miles south of Chillicothe, Ohio. This movement was caused by the settlement of the Pacific coast. The center of population in 1870 was 48 miles northeast of Cincinnati. According to the last census, the center had advanced westward 58 miles, and deflected to the South about 8, being near the village of Taylorsville, Ky., about 8 miles from Cincinnati. It is anticipated that the next census will find it in Jennings county, Indiana. Supposing the Westward movement of the population to continue, the central point should cross the Mississippi about the year 1950, not far from the mouth of the Missouri. It is considered probable, however, that it will never go so far westward, as there are large areas in the West which are only adapted for mining and grazing pursuits, and will support but a scanty population. The increase in the region beyond the Mississippi, after the close of the present century, may not much more than counterbalance that of the rest of the country, in which case the center of population will remain almost stationary in southern Illinois.

Has the Moon Water and an Atmosphere?—Herr H. Dueberg, of Berlin, in discussing this oft-discussed topic, contends for the probability of the existence of both water and air on the moon, and advances some original views in support of his opinion.

He makes allusion first to the well-known fact that the moon in her movements about the earth, always presents the same side towards us; and Herr Dueberg thinks that we are not justified in assuming from the fact that the side which we see is an airless and waterless desert, that the other side is the same in these particulars. In favor of this view, he argues that since the attraction of the earth for the moon is very great, the heavier side of the satellite must of necessity be turned towards the earth, and that therefore the lighter and fluid elements (air and water) must necessarily accumulate on her further side.

In the absence of any centrifugal force due to rotation on her own axis, the only centrifugal force acting upon the moon must be that resulting from the moon's motion around the earth. This would tend still more to throw the moon's air and water to the "outside" with respect to the earth. For a practical illustration of this view, Herr Dueberg suggests a ball swinging in a circle by means of a cord. The ball, like the moon, will always turn the same side to the center of revolution; and if it be dipped in any liquid, the liquid will be rapidly accumulated on the opposite or outer side. Hence the possibility of water, air and life on the moon, around the shores of a central lunar sea, on the side always turned away from us.

Curious Electrical Phenomenon.—The signal officer at the summit of Pike's Peak (Sergeant Day) lately reported the observation of the following curious electrical phenomenon: On opening the door at 8.45 P.M., the line on the summit was seen distinctly outlined in bright light, which was thrown out from the wire in beautiful scintillations. These, seen nearer, had the appearance of little electrified brushes or inverted cones of light, with their points to the line, whence they issued in little streams about the size of a pencil-lead of bright violet color, while the cone of the rays was of a brilliant rose-white. These cones pointed in all directions, and were constantly jumping about. There was no heat to the light, though one could not touch one of the little flames, for as soon as the finger was brought near they would instantly vanish, or jump to another point of the line. Passing along the line with extended finger, these little jets of flame were successively "puffed out," to be instantly relighted in the rear. Every exposed metallic point or surface was similarly tipped or covered. The cups of the anemometer appeared as a solid ring of fire, with a loud hissing noise. On bringing the hand near the instrument, no heat was felt; but the hand instantly became aflame, and on raising it and spreading the fingers, each of the latter became tipped with cones of light. There was a feeling as of a current of vapor escaping, and a slight tingling sensation. Other parts of the body were lighted up also.

Invention of Gas Lighting.—The city of Chaumont has just erected a statue in honor of Philippe Lebon, for whom the French claim the honor of having invented the system of lighting by gas. It is interesting, as showing how several inventors may be independently working at the same problem, to know that the English claim with equal positiveness that the honor of this invention belongs to William Murdock, a Scotchman. Both of these worthies are no doubt entitled to great credit for perfecting the invention. A number of investigators previous to their time, had paved the way for the practical application of the inflammable gas derived from coal. Great discoveries and inventions are rarely, if ever, the product of one mind.

A New Method of Bleaching.—Messrs. Dobbie and Hutcheson have investigated the various methods of liberating chlorine and decomposing hydrochloric acid and chlorides with a weak electric current. They obtained the best results by moistening the goods with sea-water and passing them between two slowly revolving carbon rollers, which were connected with opposite poles of a battery. Sodium hypochlorite was formed in the fabric, and on immersion in acid, the bleaching was effected. Results were also obtained with dilute hydrochloric acid. Pure hydrofluoric acid also bleaches when thus decomposed.

The Sun Spots.—Herr S. Wolff has lately advanced, in the French journal *Kosmos*, the theory that the sun spots, instead of being cooler than the adjacent parts of the solar surface, as is generally believed by astronomers, represent parts of the sun that are vastly hotter than the bright portions of the solar surface. They are, according to Herr Wolff, regions so intensely hot that all the heat movements emanating therefrom have reached the intensity of the ultra violet, and these being invisible, the spots consequently appear dark.

The Presence of Magnesia in Limestones, even in very small quantity, can be detected, according to Pichard, by its alkaline reaction. If the pulverized stone does not at once react on red litmus paper, he directs that a portion be heated on platinum foil just below dull redness. Pure limestone remains unchanged, but if one-1000th of magnesia is present an alkaline reaction will readily be obtained.

Novel Chess-Board.—An iron chess-board, provided with magnetic chess-men, is a Berlin novelty. The small magnets concealed in the figures cause them to adhere to the iron board and retain their places in spite of considerable shocks, such, for instance, as are received on shipboard or on railway trains.

The Signal Service and its Methods.

[*Continued from page* 132, *June Number.*]

The Rain Gauge, which is an essential portion of the outfit of an observer, is made the subject of the following series of instructions: It must be placed, whenever practicable, with the top of the funnel-shaped collector twelve inches above the surface of the ground, firmly fixed in a vertical position, and protected from the interference of unauthorized persons. It must be examined at the time of making each of the three telegraphic observations, the amount of water, including fog or dew, it contains carefully measured by means of the graduated rod sent with each gauge, and then emptied and returned to its proper position. When a position at the level of the ground cannot be found with a sufficiently clear exposure, the gauge must be placed on the top of the instrument-room, or roof of the building occupied by the observer, who is directed to measure the hight above the ground and report it to the central office. The measuring rod is graduated in inches and tenths of inches, and the proportion between the cylinder and funnel is as 1 to 10, so that 10 inches upon the rod correspond with 1 inch actual rain-fall, 1 inch on the rod to one-10th of rain, and one-10th on the rod to one-100th of rain. Snow must be melted, and then measured and reported in the same manner as rain. Whenever from any cause the snow cannot be melted, the depth must be measured and 10 inches of snow reported as 1 inch of rain-fall. Stations in localities subject to heavy rain-fall are supplied with an attachment to the gauge of sufficient capacity to guard against overflow; but at stations where such rains are exceptional, care must be taken by the observer to prevent overflow during heavy rain.

The Clock must be hung upon the interior wall of the room occupied as an office, and carefully adjusted to the standard local time of the station. As it frequently happens that the telegraph time differs from the standard local time, the observer must be careful to note the amount of this difference, in order to avoid confusion in filing his reports. As the time by which the observations are governed must be as nearly correct as practicable, the observer will endeavor to arrange with the manager of the telegraph office to have both clocks run together as a sure means of preventing errors.

The more important stations are provided with a press for printing the weather maps, and explicit directions are given for using the same, and concerning the materials required to be used in connection with this operation, which, however, are not of sufficient general interest to warrant reproduction.

River Gauge.—No definite form of river gauge has been adopted by the office, owing to the difficulty of getting one at reasonable cost that would be adapted to the different circumstances under which it would require to be used. The following mode of devising a simple water gauge is recommended as affording a sufficiently accurate instrument for most purposes: Take a piece of pine scantling, from 1¼ to 1½ inches in thickness, and from 5 to 6 inches in breadth, the length varying according to the depth of water where it is to be used. Having planed the scantling smooth, give it a heavy coat of white zinc paint, and after the paint is dry divide the scantling into feet and inches with a rule and lead pencil. With a small brush paint the inches black, except the center and initial ones of each foot, which should be painted red, and in heavier lines than the intermediate ones. Indicate each foot with its proper number in plain figures marked on the white surface just above the triangle. Having marked the gauge up to a sufficient hight to include the point of maximum high water, select a pile or other stationary object in some portion of the levee or wharf where the gauge will be secure from injury, and where it will not be left dry by the tide or by low water. Lower the gauge into the water, taking care to keep it in a vertical position until it touches the bed of the river or its zero is at the bench-mark or water level in common use by river men; then firmly secure it to the pile, or other object selected, by spikes. If no suitable vertical object can be found to which to fasten the gauge, a gauge should be constructed according to the following directions: Procure a piece of pine or oak timber, 2 inches thick by 10 inches in width, and of sufficient length to cover the full range of the river between extreme low-water and high-water marks. This timber should be placed edgewise and firmly embedded in the earth, leaving 1½ inches of its width exposed above the level of the ground. The upper edge must be planed smooth and carefully graduated in feet and inches, after being placed in position, taking the established bench mark or level previously referred to in this paragraph as the zero of the scale, and numbering the feet and inches, both above and below that point, unless it is at extreme low-water mark, in which case the numbers will all be above the zero of the scale (see Figs. 12 and 13). Especial pains should be taken in graduating the gauge to see that the distances marked off upon it for each foot, and its subdivisions, correspond exactly to the vertical foot and subdivisions of which they are the measure. This can be readily done by means of an ordinary spirit level, a straight-edge on which to place the level, and a graduated rod fixed vertically, from which to take the measurement. When the gauge is in an exposed place, advantage should be taken of the first low water to secure it from being displaced, by driving in additional spikes, lashing it with strong cords, or otherwise securing it from being washed away. After securing the gauge, fix some point of reference so that in case it should be destroyed another could be put up at the same hight. This may be done by marking on some given point in the vicinity any given hight of the water. Thus, by driving a spike or drilling a hole, and recording the hight of the water as read at the time, a "bench-mark" or point reference is obtained by which to set up another gauge. A sketch of the place must be made, giving the location of the gauge and the point of reference, noting the names of surrounding points, so that the place may easily be found by others. In addition to the changes of the past twenty-four hours, observers are required also to give the hight of water above or below the zero of the gauge, as the case may be. River observations must be made with great care and reported regularly.

FIG. 12.

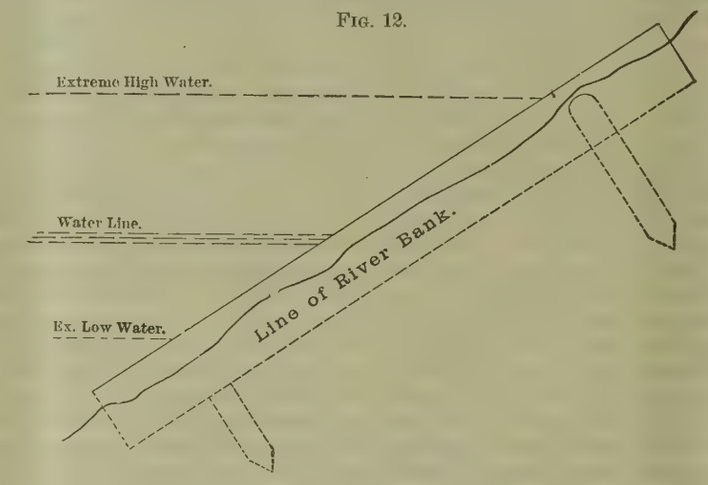
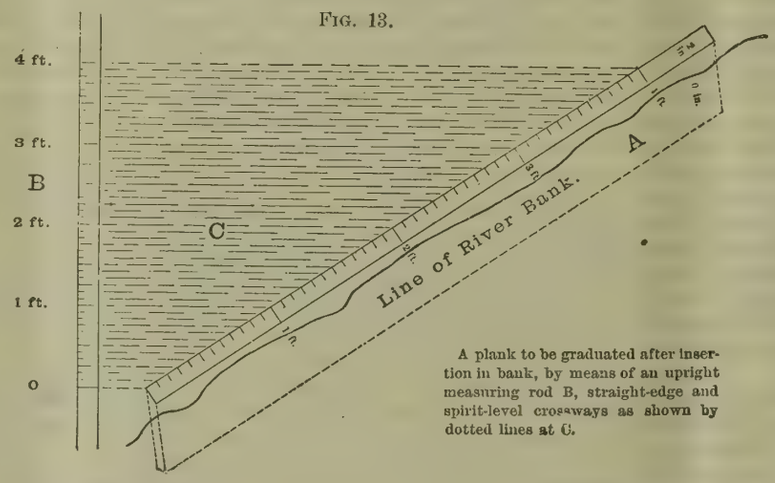


FIG. 13.



A plank to be graduated after insertion in bank, by means of an upright measuring rod B, straight-edge and spirit-level crossways as shown by dotted lines at C.

"Crackle" Glass.

An ingenious process for producing glass with an iced or crackled surface, suitable for many decorative purposes, has been invented in France by Bay. The product appears in the form of sheets or panes, one side of which is smooth and glossy, like common window glass, while the other is rough and filled with innumerable crevices, giving it the frozen or crackled appearance so much admired for many decorative purposes. This peculiar crackled surface is obtained by covering the surface of the sheet on the table with a thick coating of some coarse-grained flux mixed to form a paste, or with a coating of some more easily fusible glass, and then subjecting it to the action of a strong fire, either open or in a muffle. As soon as the coating is fused, and the table is red hot, it is withdrawn and rapidly cooled. The superficial layer of flux separates itself in this operation from the underlying glass surface, and leaves behind the evidence of its attachment to the same, in the form of numberless irregularities, scales, irregular crystal forms, etc., giving the glass surface the peculiar appearance to which the above name has been given. The rapid cooling of the glass may be facilitated with the aid of a stream of cold air, or by continuously projecting a fine spray of cold water upon it. By protecting certain portions of the glass surface from contact with the flux, with the use of a template of any ornamental or other desired form, these portions will retain their ordinary appearance, and will show the form of the design very strongly outlined beside the crackled surface. In this manner, letters, arabesque and other patterns in white or colored glass can be produced with great ease and with fine effect.

EXPLOSIVE ZINC ALLOYS.—Debray and Deville have lately made some curious observations respecting the alloys of zinc with the platinum metals. They found that, with the exception of osmium, all these metals obstinately retain from 10 to 12 per cent of zinc when these alloys, containing a large excess of zinc, are treated with an acid capable of dissolving this metal. They found, also, that an alloy of osmium, iridium and zinc, if heated to about 572° Fah., takes fire suddenly—almost with explosive violence, diffusing fumes of zinc and of osmic acid.

Market Report of Building Materials.

NEW YORK PRICES.

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LUMBER.

Pine, very choice and extra dry, ₱ M	$65 00 @ 75 00
Pine, good	55 00 @ 60 00
Pine, shipping box	21 00 @ 22 50
Pine, common box	18 00 @ 20 00
Pine, common box 5/8	16 00 @ 18 00
Pine, tally plank, 1¼, 10 inch, dressed each	— 44 @ — 50
Pine, tally plank, 1¼, 2d quality	— 35 @ — 38
Pine, tally plank, 1¼, culls	— 28 @ — 30
Pine, tally boards, dressed, good	— 30 @ — 32
Pine, tally boards, dressed, common	— 25 @ — 28
Pine, tally boards, culls, dressed	— 23 @ — 25
Pine, strip boards, merchantable	— 18 @ — 20
Pine, strip boards, clear	— 24 @ — 26
Pine, strip plank, dressed, clear	— 33 @ — 35
Spruce boards, dressed	— 25 @ — 26
Spruce plank, 1¼ inch, dressed	— 28 @ — 30
Spruce plank, 2 inch	— 43 @ — 45
Spruce wall strips	— 15 @ — 16
Spruce timber, ₱ M	19 00 @ 21 00
Hemlock boards, ₱ M	17 00 @ 18 00
Hemlock joist, 2½x4, each	— 16 @ — 17
Hemlock joist, 3x4	— 18 @ — 20
Hemlock joist, 4x6	— 40 @ — 44
Ash, good, ₱ M	55 00 @ — —
Oak	60 00 @ 65 00
Maple culls	25 00 @ 30 00
Maple good	45 00 @ 50 00
Chestnut	48 00 @ 52 00
Cypress, 1, 1½, 2, and 2½-inch	35 00 @ 40 00
Black Walnut, good to choice	115 00 @ 125 00
Black walnut, ⅝-inch	85 00 @ 100 00
Black walnut, selected, and seasoned	150 00 @ 175 00
Black walnut, counters, ₱ ft	— 22 @ — 28
Cherry, wide, ₱ M	100 00 @ 120 00
Cherry, ordinary	60 00 @ 80 00
White wood, inch	45 00 @ 50 00
White wood, ⅝-inch	35 00 @ 40 00
White wood, ⅝ panels	42 00 @ 45 00
Shingles, extra sawed pine, 18-inch	4 00 @ 5 00
Shingles, clear sawed pine, 16-inch	4 00 @ 4 50
Shingles, cypress, 24x6	18 00 @ 20 00
Shingles, cypress, 20x6	11 00 @ 12 00
Lath, Cargo rate	2 25 @ — —
Yellow dressed pine flooring	30 00 @ 40 00
Yellow pine girders	32 50 @ 40 00
Locust posts, 8 feet, ₱ inch	— 18 @ — 20
Locust posts, 10 feet	— 24 @ — 25
Locust posts, 12 feet	— 29 @ — 34
Chestnut posts, ₱ ft	— 3 @ —3½
Basswood ₱ M	25 00 @ 30 00

Cargo rates 10 ₱ cent off.

CEMENT—PER BARREL.

Portland (imported)	2 65 @ 2 85
Portland (American)	2 30 @ 2 75
Portland (Lafarge)	3 60 @ 3 75
Lime of Teil	2 30 @ 2 50
Lime of Teil, ₱ ton	15 00 @ 18 00
Roman	3 00 @ 3 25
Keene's & Martin's, coarse	6 00 @ 6 50
" fine	10 50 @ 10 75
Rosendale	1 10 @ 1 15

SOLDERS.

Half and half	16½ @ — 16¾
Extra	15½ @ — 15¾
No. 1	14 @ — 14¼

ZINC.—Duty, sheet, ₱ ℔, 2½ cents.

Sheet (cask) ₱ ℔	7¼ @ — 7½
Sheet (open)	8 @ — 8¼

BRICKS.

	Cargo.	Afloat.
Pale, ₱ M	3 00 @	4 00
Up Rivers	5 25 @	6 00
Jersey	5 00 @	5 75
Haverstraw Bay	6 00 @	6 25
" choice	6 50 @	6 75
Favorite Brands	7 00 @	7 25
Hollow Fire-Clay Brick	9 00 @	9 25

FRONTS.

Croton—Brown, ₱ M	11 00 @ 12 00
" Dark	12 00 @ 14 00
" Red	12 00 @ 14 00
Philadelphia, on pier	30 00 @ — —
Trenton "	30 00 @ — —
Baltimore "	38 00 @ 40 00
Clark's Glens Falls, White	30 00 @ — —
" " Red Fronts	27 50 @ — —
" " Molded Red and White	45 00 @ 80 00

Yard prices 50 cents ₱ M higher, or with delivery added $2 ₱ M for hard and $3 ₱ M for front brick. For delivery add $5 on Philadelphia, Trenton and Glens Falls and $6 on Baltimore brick.

STONE.—Cargo Rates Delivered in New York.

Amherst Freestone, No. 1, in rough, ₱ c. f	1 00 @ — —
do do No. 2	— 85 @ — 95
Bedford Stone	1 25 @ — —
Berlin Freestone, in rough	— 75 @ 1 00
Berea Freestone, in rough	— 75 @ 1 00
Brown Stone, Portland, Conn	1 00 @ 1 35
Bay of Fundy Wood Point Brown Stone	1 00 @ — —
do Mary Point Brown Stone	1 00 @ — —
do do Olive Stone	1 00 @ — —
Brown Stone, Belleville, N. J	1 00 @ 1 35
Granite, rough	— 60 @ 1 25
Canaan Marble	1 25 @ 1 50
Sutherland Falls Marble	1 25 @ 1 75
Dorchester, N. B., Stone, rough, ₱ foot	1 00 @ — —

LEAD—PER 100 POUNDS.

German	— — @ — —
English, common	— — @ — —
Spanish	5 75 @ — —
Foreign, refined	— — @ — —
Bar	6 50 @ — —
Sheet	7 50 @ — —
Pipe	— — @ — —
Domestic	4 63 @ — —

TIN PLATES.—Duty, 1 1/10 cents ₱ ℔.

I. C. charcoal, 10x14, ₱ box	6 25 @ 6 50
I. C. coke, 10x14	5 25 @ 5 75
I. X. charcoal, 10x14	8 25 @ 8 37½
I. C. charcoal, 14x20	6 25 @ 6 50
I. X. charcoal, 14x20	8 25 @ 8 37½
I. C. coke, 14x20	5 25 @ 5 75
I. C. coke, terne, 14x20	5 25 @ 5 37½
I. C. charcoal, terne, 14x20	5 50 @ 5 75

NAILS—PER KEG.

10d to 60d, common, fence and sheathing	3 30 @ 3 40
8d and 9d, common	3 65 @ — —
6d and 7d, common	3 90 @ — —
4d and 5d, common	4 15 @ — —
3d and 4d, light	4 95 @ — —
3d, fine	5 05 @ — —
2d, fine	5 05 @ — —
Cut spikes, all sizes	3 65 @ — —
Clinch nails, 1½ to 1¾ inch	5 65 @ — —
do. 2 to 2½ inch	5 40 @ — —
do. 2½ to 2¾ inch	5 15 @ — —
do. 3 inch and longer	4 90 @ — —

IRON—PER TON.

Duty.—Bar, 1 to 1½c. ₱ ℔. ; Railroad, 70c. ₱ 100 ℔. ; Boiler and Plate, 1½c. ₱ ℔. ; Sheet, Band, Hoop, and Scroll, 1¼ to 1¾c. ₱ ℔. ; Pig, $7 ₱ ton ; Polished Sheet, 3c. ₱ ℔. Galvanized, 2½c. ₱ ℔. ; Scrap cast, $6 ₱ ton ; Scrap Wrought, $5 ₱ ton—all less 10 ₱ cent. No Bar Iron to pay a less duty than 35 ₱ cent ad val.

Pig, Scotch—Coltness	26 00 @ 27 00
" Glengarnock	24 00 @ 25 00
" Eglinton	23 00 @ 24 00
" American, No. 1	25 50 @ 27 00
" American, No. 2	23 50 @ 24 50
" American forge	22 00 @ 23 00

PAINTS.

Carmine, American, ₱ ℔	5 00 @ 5 25
Chalk, ₱ 100 ℔s	— 35 @ — —
China Clay, ₱ ton	18 00 @ 20 00
Chrome yellow, dry, ₱ ℔	— 12½ @ — 28
Lead, red American, ₱ ℔	— 6¾ @ — 7
Lead, white American, pure, in oil	— 7½ @ — 8
Lead, white American, pure, dry	— 6¾ @ — 7
Lead, white English, pure, in oil	— 9 @ — 10
Litharge	— 6¾ @ — 7
Ocher, Fr., dry, ₱ 100 ℔s	1 50 @ — —
Ocher, ground, in oil, ₱ ℔	— 6 @ — 15
Ocher, Vermont, ₱ 100 ℔s	— 75 @ 1 00
Orange Mineral, English	— 9 @ — 10
Paris White, American	— 1½ @ — 1¾
Paris White, English, prime	— 2 @ — 2¼
Paris Green	— 15 @ — 28
Plumbago paint, patent, ₱ ℔	— — @ — 25
Putty, ₱ ℔	— 2 @ — 2½
Spanish Brown, dry, ₱ ℔	— 1¼ @ — 1¼
Spanish Brown, ground in oil, ₱ ℔	— 8 @ — 9
Venetian red, ₱ cwt	1 75 @ 2 00
Vermilion, Chinese, ₱ ℔	— 85 @ — 90
Vermilion, Trieste	— 70 @ — 75
Vermilion, quicksilver, bags	— 50 @ — 52½
Vermilion, American, common	— 15 @ — 18
Whiting, ₱ 100 ℔s	— 60 @ — 80
Zinc, white American, dry, No. 1	— 5 @ — 7½
Zinc, white American, No. 1, in oil	— 8 @ — 10
Zinc, white French, dry, (Red Seal,)	— 7 @ — 8
Zinc, white French, in oil	— 10 @ — 10½

VARNISHES—PER GALLON.

American Wearing Body	3 50 @ 4 00
Coach Body	2 35 @ 3 50
" "	1 80 @ 2 00
Furniture	1 25 @ 2 50
Black Asphaltum	1 00 @ 1 50
Brown Japan	1 00 @ 1 20
Liquid Paint Dryer	1 35 @ 1 75
Harness, (black)	3 00 @ 4 50
Shellac, Spirits	3 00 @ 3 50

LIME—PER BARREL.

State, common	— 85 @ — —
" finishing	1 10 @ — —
Rockland, common cargo rate	1 00 @ — —
" finishing	1 10 @ — —
Ground	— 85 @ — 90

Add 25 cents to above figures for yard rates.

HAIR.

Cattle, ₱ bushel of 7 ℔s	— 18 @ — 21
Goat " "	— 30 @ — 35

SLATE.

Purple, roofing slate, ₱ square	$6 00 @ 7 00
Green Slate	6 00 @ 7 00
Red Slate	13 00 @ — —
Black Slate, Pennsylvania, (at Jersey City)	4 75 @ 5 25
Slate tiles, 1¼-inch, rubbed, ₱ square foot	— 20 @ — 25

PLASTER PARIS.

Duty.—20 ₱ cent ad. val. on calcined ; lump free.

Calcined, ordinary city, ₱ bbl	1 30 @ 1 35
Calcined, city casting	1 50 @ 1 65
Calcined, city superfine	1 70 @ 1 75

MAHOGANY.

St. Domingo, crotches, ordinary to good, ₱ ft	— 15 @ —28
St. Domingo, crotches, fine	— 20 @ —30
St. Domingo, logs, small	— 5 @ —38
St. Domingo, logs, large	— 12 @ —15
Frontera, Mexican, large	— 12 @ —15
Frontera, Mexican, small	— 6 @ — 8
Other Mexican	— 6 @ —12½
Honduras	— 6 @ —12½

ROSEWOOD.

Rio Janeiro, ordinary to good, ₱ ℔	— 2½ @ — 4½
Rio Janeiro, good to fine	— 5 @ — 8
Honduras	— 6 @ — 12½
Satin Wood, ₱ foot	— 15 @ — 75
Tulipwood, ₱ ℔	— 6 @ — 7
Lignumvitæ, large, ₱ ton	30 00 @ 50 00
Lignumvitæ, other sizes	10 00 @ 25 00

CEDAR.

Cuba and Mexican, small, ₱ super. ft	6 @ — 7½
Cuba and Mexican, medium	8 @ — 9½
Cuba and Mexican, large	10 @ —11
Florida, ₱ cubic foot	40 @ —75

DEADENING AND ROOFING MATERIAL.

Mineral wood for Roofs and deadening, ₱ ℔	— 1¼ @ —1½

LABOR.

Ordinary, ₱ day	2 00 @ 2 50
Masons, do	3 50 @ 4 00
Plasterers, do	4 00 @ — —
Carpenters, do	4 00 @ — —
Plumbers, do	4 00 @ 4 50
Painters, do	3 00 @ 3 50
Stone-Cutters, do	3 00 @ 3 50

REVIEW OF THE MARKETS.—In the lumber market the selling interest during the past month has retained pretty much all the advantage, and has been making some little gain nearly every day. There has been no "boom" in the market, or tendency to such, so far as can be discovered, and it has been one of the healthiest features of the position that buyers have readily admitted the necessity for naming full bids on desirable stock, and have been willing to negotiate when anything really attractive has been tendered them. In fact, the market has been working in strict accord with natural laws, and if this situation can be retained during the next two or three months there will be a chance for striking some sort of a balance against the unfavorable conditions under which operators labored during the first half of the year.

In the brick market common hards have undergone no very radical change in values, but the downward tendency seems to have received a check again, and there has been a steadier feeling extant. This change for the better has been attributed in the main to the lighter run of supplies, the regular vessels, without any very distinct cause or special effort on the part of captains, having come to hand in a comparatively slow manner, and permitted agents here to keep the market well sold up. This naturally indicates that the demand has not in any way fallen off, and that buyers evidently appreciate the low cost of stock. The inferior and medium grades have secured a good proportion of the attention, but there has been a noticeable strong tendency to direct the demand particularly toward the choice qualities, and the latter in consequence have been best sustained, and have occasionally excited a little competition among anxious buyers. The supply has been moving, in the majority of cases, directly toward consumption, but dealers now and then find a cargo possessing sufficient attractions, both in the way of quality and cost, to induce them to lay it away for stock.

In the lime market Rockland has been nominal, owing to the absence of supplies. There has seemed to be quite a strong undertone current, however, and scarcely a doubt is entertained that upon the new offering, when made, an advance will be asked. State lime has been firm, and will, it is expected, follow the Eastern product.

In the lath market there has been considerable stock sold during the month, and the claims made by receivers that a good demand could be depended upon are fully supported, but they were not so lucky in their prediction regarding price, which has taken quite a set back.

In the hardware market business has been assuming better general shape, and there has been a good fair market, with a tendency to improve as the season progresses. All local jobbers, etc., are in want of supplies, and commence to secure them, while from the interior the orders thus far received tend to confirm previous reports of reduced and broken assortments. The offerings here of both domestic and foreign stock have as yet been ample for all calls made, but in no instance excessive; and manufacturers deem it judicious to continue the production without check for the present. On values there has been naturally much strength, with strong expectations that prices will advance on some of the leading grades.

In the metal markets American pig has retained a healthy and promising condition, and most of the trade have been apparently in a cheerful mood. Sales, as a rule, but in small lots, have reached a fair aggregate, which, coupled with the deliveries making on old contracts, has prevented any serious accumulation. Prices have been naturally firm, and have tended to favor the seller if anything. Manufactured iron has been in good general demand on trade orders, with some contracts under consideration, and the tone firm throughout. Domestic pig lead has ruled somewhat easier in tone under a rather moderate jobbing trade and a pretty fair supply of stock. Pig tin has met with a good average jobbing distribution, and, as a rule, at pretty fair rates. Tin plates have not sold very readily in round lots, but a pretty good general jobbing demand has been current, and stocks are steadily held for full rates. Sheet zinc has been selling about as usual, and closed steady.

Machinery and Process for Beet Sugar Manufacture.

BY LEWIS S. WARE, C. E.

It is impossible to assert, even in a general way, what process or machinery is most desirable for beet sugar manufacture—the quality of the beet, the cost of labor, fuel, limestone, etc. With this, an abundance of money and water are all factors that are of vast importance, and should be considered.

The complexity of the question is made apparent when the endless inventions of the past fifty years are examined. The German methods differ from the French, and the latter from the Austrian. The Dutch and Russians have also their special machinery and patent processes, which, under certain circumstances, have much to commend them. The problem of beet sugar manufacture does not only depend upon the apparent simple operation of extracting the juice from the beet, but also upon the intricate methods of manipulating the saccharine juices. The success in all cases of the entire process, whatever it be, depends upon the care bestowed upon hundreds of analyses, which are most varied, one method frequently leading to an entirely different result from another, which, upon general principles, seems paradoxical, but nevertheless true, that are continuously made to determine the loss of sugar in the refuse pulp and molasses, or the lime absorbed by the bone-black or the decolorizing properties of the latter, or, in other words, the direct actions of the various chemicals made use of. Such being the case, it becomes evident that machinery, whatever kind it be, will give inferior results if not managed by those versed in the technicality of its workings. Frequently a loss of $\frac{1}{4}$ per cent of sugar will lead to small final profits, which is very discouraging to the manufacturer.

Evidently, if we become familiar, and experiment under the same conditions, with all existing machinery and processes, we would then be able to determine definite principles, valuable to all those intending to launch upon the difficulties of manufacturing sugar from the beet. Whatever be the selection made, it should be adhered to, as before stated, and every detail throughout the factory should be made especially and adequate to the requirements; the piping, etc., of sizes best suited, as determined by calculation, not using, as is too frequently the case, with the view to economy, those nearest at hand, regardless of the difficulties that they may possibly offer if their diameters be not of the determined size. The importance of properly placing the pipes, as determined in advance, is too often overlooked, which principle, if neglected, may upset the economical working of the entire establishment.

The greater the unnecessary length, the greater the internal friction offered to the circulating liquids, the greater will be the loss of power, resulting in waste of fuel, etc. If the plans of the piping be made in advance, the setting up, adjusting, etc., will require but a comparatively short time. If, on the other hand, the machinery be placed in position and the piping be subsequently attended to, the expense for adjusting, altering, loss of time, etc., amounts in some cases to thousands of dollars. We could give several existing examples of how in Canada and the United States money was thrown away. One factory in the former country spent half as much again upon its piping as it would have cost in Europe, and transportation to destination included. The loss of time and money amounted to no less than $10,000. The roots were in waiting, and one thousand tons rotted, owing to a change in the weather.

Upon general principles, the manufacture of beet sugar consists in the washing of the roots, the extraction, purification and decolorization of the juice; the concentration, granulation of the syrup, separation and purification (or refining) of the sugar. Besides these operations, there are many intervening, their number depending upon the methods of working. The washing of the beets is apparently a simple operation, but demands in reality many conditions. In all cases it should be made to suit the requirements; for example, we consider it a mistake to purchase a washer capable of washing 200 tons of roots in 24 hours when in reality but one half that amount is needed for a 100-ton factory. The conditions of its working would thus be very irregular, for the delivery of beets to the rasp or slicer would be twofold greater than it should be. A large receiving tank is then needed, and the washer is working but one half the time—the continual starting and stopping corresponds to a wear and tear upon all the mechanical working parts, and demands an extra hand for the emergency. The supposed saving in purchasing what is not needed is represented in reality by a loss.

We have here taken an extreme view of the case, to caution those having had no experience. It is, on the other hand, in some cases desirable to make allowance for subsequent increase of the working capacity of the factory. The type of the washer depends upon the variety of the roots to be washed, the nature of the soil on which they were grown, and the manner of harvesting. For example, if a soil be strong, roots will grow very irregularly, frequently forked, having stones embedded in them. The gathering of the roots, or harvesting, is often carelessly done; dirt is delivered at the factory with the roots, with the view of increasing the tonnage at the beets' expense. The advantage or disadvantage of a double or single system of washer, or the use of pulleys instead of cog wheels to transmit the rotary movement, are questions that have their importance and cannot be determined upon a simple examination, for if they could there would be no possible reason why the fifteen hundred European beet sugar factories should not adopt one universal type.

The roots, on leaving the washer, are generally carried by an endless chain either to a rasp or a slicer, the former for hydraulic and continuous presses, and also for various macerating processes. The continued blade, and also the spiral rasp types, produce pulps of different kinds, and are desirable or not, depending upon the amount of pressure to be subsequently exerted directly or gradually through the intervention of several rotating cylinders, etc. The using of water in large quantities, the rapid movement of the drum upon which the rasp blades are mounted, the advantage of reversible blades, etc., are only a few of the difficulties which the rasp question presents. The slicer, on the other hand, has justified endless technical discussion, with the view of determining the most desirable shape for the corsettes to have in order to be possessed of the greatest diffusing properties, this evidently varying with the manner of working the diffusion battery, the kind of battery, etc. The duration, number, kind of blades, manner of sharpening, their position in the slicer to produce the maximum effect, the advantage of giving the movement above or below, and the objections to a continued or alternative feeding of the apparatus, are all questions of greater importance than many suppose. The position of the slicer or rasp, as regards the most economical and desirable manner of feeding the apparatus, and in which the pulp or corsettes are to be subsequently treated, are problems depending upon the price of labor, the horizontal or vertical space that may be disposed of, the general arrangement of shafting, etc.

While it may be advisable to run corsettes directly into the diffusing battery in some cases, it may be advantageous in others to receive and weigh them in iron wagons moving on tracks. The advisability of using or not using hydraulic presses, depends upon the facilities offered as to labor, fuel, etc. While they are to be condemned in some cases, they may be highly recommended in others, and for years they found much favor in France and Belgium; the annual expense of linen sacks, and the possibility of rapid fermentation of the extracted juices, are in themselves objections; but the simplicity of the method is an advantage. The advisability of the ram, of the press working from bottom to top, or top to bottom, with the view of increasing the effect, are mechanical questions that have only been partially decided. The horizontal or vertical types of hydraulic presses have both much to commend and condemn them. Exactly how and why, should be familiar to all those attempting or advocating their use.

The continuous presses created a great furore in France for many years. The number of cylinders, the endless bands, the manner of feeding the pulp to the press, the total pressing effect, the quality of resulting juices, the wear and tear of the machines, the simplicity of the method, the power consumed, the high or low price of the apparatus as compared with others having the same object in view, and the advantages of a double continued press, are all questions that have been practically settled to-day; and those advocating this system of working should be familiar with the results as determined by numberless experiments of others. Hundreds of pages would be required to enter into details of the excellent or indifferent work that these continuous presses have done. Why they are still adopted in some cases, and why they should be abandoned in others, are questions one should be familiar with before recommending or condemning their use.

[*To be Continued.*]

Valuable Census Tables.

LEADING IMPORTS AND EXPORTS OF THE UNITED STATES—1881.

Exports.	Value.
Cotton	$250,000,000
Wheat and flour	212,000,000
Provisions	150,000,000
Corn	50,000,000
Oils	42,000,000
Tobacco	20,000,000

IMPORTS.

	Value.
Sugar	$90,000,000
Coffee	56,000,000
Iron and steel, and manufactures of	50,000,000
Wool, " "	45,000,000
Silk, " "	42,000,000
Hides	27,000,000
Flax, and manufactures of	21,000,000
Tea	21,000,000
Tin	14,000,000
Fruits	12,000,000
Hemp	10,000,000

AMOUNT AND VALUE OF SIX LEADING AGRICULTURAL PRODUCTIONS OF THE UNITED STATES CENSUS REPORT 1880.

		Value.
Corn	1,754,861,535 bushels.	$600,000,000
Wheat	459,479,505 "	500,000,000
Hay	35,493,000 tons.	330,000,000
Cotton	2,725,198,000 pounds.	242,000,000
Oats	407,858,999 bushels.	130,000,000
Potatoes	132,837,174 "	73,000,000

ELECTRIC CONDUCTIVITY OF METALS.—Taking silver as the basis of comparison, the following table shows the relative electric conductivity and resistance of various metals:

	Conductivity.	Resistance.
Silver	100	100
Copper	90	111
Gold	65	154
Zinc	24	417
Brass	18	556
Iron	15	667
Platinum	14	714
Tin	14	714
Lead	8	1250

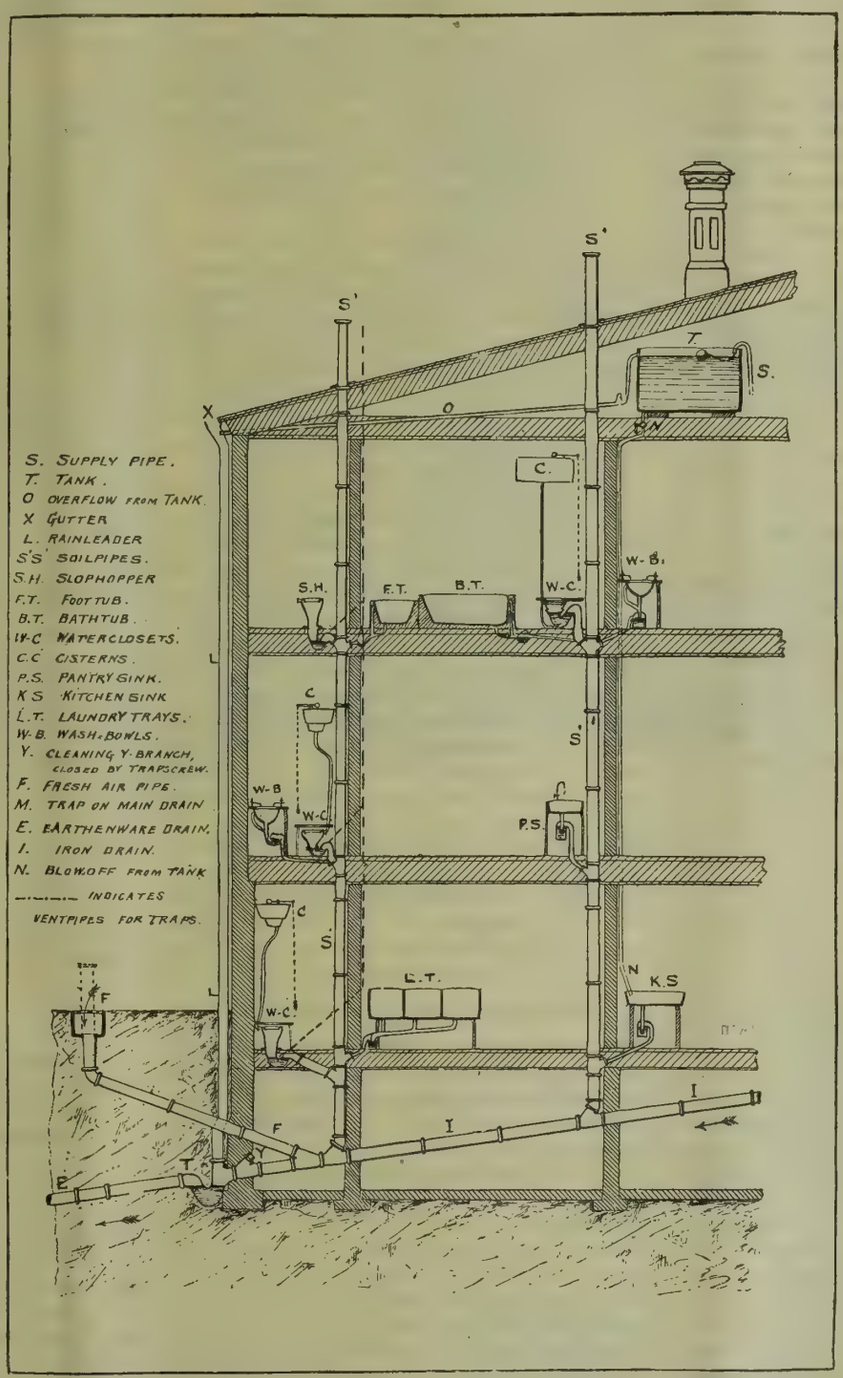
NEW METHOD OF NICKEL-PLATING.—Instead of employing an ammoniacal double salt of nickel in an alkaline solution, Powell uses a neutral or slightly alkaline solution, containing certain organic acids. He dissolves 90 parts (by weight) of sulphate of nickel, 25 of citrate of nickel, and 15 of benzoic acid in 4,000 of water.

House Drainage and Sanitary Plumbing.

In an excellent report on the above subjects, recently made to the State Board of Health of Rhode Island, by Wm. Paul Gerhard, we find much sound advice and many good suggestions. We make in the following an abstract of certain portions of this report which appear to us to be of general interest and importance.

The author names three cardinal objects to be fulfilled by a perfect system of house drainage, namely: 1. To remove from the inside of the dwelling as quickly as possible all liquid and semi-liquid wastes, whether it be the soapy discharge from wash-bowls, bath-tubs and laundry-tubs, or the vegetable refuse from the scullery sink, the greasy matter from kitchen and pantry sinks, or the foul discharges from slop sinks, urinals and water-closets. 2. To prevent the foul gases originating from the decomposition of the above matters in the drain, sewer, cesspool or flush-tank from returning through the same channels into our dwellings. 3. To oxidize and render innocuous by a copious flushing with air the foul gases due to the possible putrefaction of waste matters within the house drains, soil and waste pipes, at the same time properly protecting all outlets of fixtures from the entrance of these gases.

The house drain is the means for conveying the sewage from the dwelling. Its proper material is a question of great importance. Outside of the dwelling it should be of vitrified pipe, circular in shape, which is superior to cement pipe. Neither brick channels nor wooden conduits should be used for this purpose. Only strong, hard, well-burnt, vitrified pipe, free from cracks or other defects, should be used. Four-inch pipes, and those of smaller size, are especially liable to warping, and should be carefully inspected and selected. The interior of these pipes should be well glazed and smooth throughout; the pipes should be impervious, true in section, perfectly straight, and of a uniform thickness. All pipes should be laid in straight lines; all changes of direction should be effected by curves of as large a radius as possible, formed of bent pipes. All branches should join the main under an acute angle, by special Y pieces, as a right-angled junction by a T branch tends to form eddies, and consequently deposits in the main drain. The joints of the pipes should receive particular attention. The danger arising from imperfect or leaky joints is two-fold—namely, first, the sewage, by soaking into the ground, pollutes the soil and endangers the purity of the water supply in places where houses are dependent on wells and cisterns for water; the ground around and under the house is more and more subject to contamination, and in winter time, when there is a strong inward draft into houses from fire-places and stoves, the tainted "ground air" is thus sucked into our very living and sleeping rooms, often producing illness. The second danger resulting from leaky joints is equally patent. The solid matters, carried in suspension in the pipes, are deprived of a part of their liquid carrier, and thus tend to accumulate and form deposits in the house drain, which soon undergo decomposition and fill the drains and pipes with noxious gases.



SYSTEM OF HOUSE DRAINAGE AND SANITARY PLUMBING.

The author dwells at length on the necessity of preventing the leakage of joints. He refers to the grade of the drain as a matter of prime importance. The velocity of the water flowing through a drain depends on its inclination, and if this is insufficient, deposition of sediment will occur and the drain will in time become choked. He recommends a fall of 1 in 40 or 1 in 60 for pipes of 4 or 6 inches diameter, and names a fall of 1 in 100 as the least to be given to small house drains, in order that they shall be, and remain, self-cleaning. Where the available fall is less than this minimum, he urges the use of special flushing apparatus. On the subject of the proper size of house drains, the author affirms that for an ordinary city dwelling a drain 4 inches in diameter is ample, even including all the rain-fall. For a larger lot and residence a 6-inch drain is all that is needed, even if the fall should be only 1 in 100. A 4-inch pipe, laid at a grade of 1 in 100, and running half full, discharges 7.5 cubic feet per minute, or 10,800 cubic feet per 24 hours. Assuming 75 gallons, or 10 cubic feet per head per 24 hours, and doubling this to provide for a maximum flow, it will be seen that this quantity is equal to the sewage of $^{10800}/_{20}$=540 persons, or of 90 houses (6 persons to a house).

The earthenware drain should end at about 5 to 10 feet outside of the foundation walls of the house. From this point towards the inside of the house the drain should be of iron. The joint between the iron drain and earthenware pipe should be made with pure hydraulic cement. Where the iron pipe passes through the wall, a relieving arch should be built over it. Settlement of walls often occurs, and is liable to crack the pipe, or even break it, unless the above provision is carried out. It is quite evident that, under no circumstances whatever, should this part of the house drain consist of vitrified pipe.

The best course of the iron drains in the house is along the ceiling of the cellar, or along one of the foundation walls. In other words, wherever practicable, the iron drain ought to be kept in sight, in order to enable anybody to detect a leaky joint at occasional inspection. The course of the drain should be as straight as possible, and all changes in direction should be made by iron bends. Waste pipes should be of cast iron, and should enter the iron drain by means of quarter bends or a Y branch with an eighth bend. To guard against corrosion, and to facilitate the flow of its contents, the author recommends that soil pipes should be coated outside and inside with coal tar pitch. Soil pipes should never be larger than 4 inches inside diameter, and waste pipes (of iron) should be 2 inches, and the arrangement of both should be as direct as possible.

The author gives the following as the essential elements of a system of plumbing: 1. Extension of all soil and waste pipes through and above the roof. 2. Providing a fresh-air inlet in the drain at the foot of the soil and waste pipe system. 3. Trapping the main drain outside of the fresh-air inlet, in order entirely to exclude the sewer air from the house. 4. Providing each fixture, as nearly as possible to it, with a suitable trap. 5th. Providing vent pipes to such water seal traps under fixtures that are liable to be emptied by siphonage.

This system is practically illustrated in the accompanying diagram, which shows a section through a city house, provided with these essential elements of house drainage.

We shall enter into more detailed description of these features in our next issue, as want of space will not allow of it here.

Longevity as a Measure of Happiness.

During his last expedition to Central Asia, Professor Vambéry managed to interview the Emir of Samarcand—a sort of Mohammedan prince-cardinal and primate of the Eastern Sunnites. As Imam of the local lyceum, the Emir appeared to take a natural interest in the progress of European science, but when his guest expatiated on the material prosperity of the Western Giaours, he interrupted him with a less expected question.

"The happiest people on earth, you call them? What age do they generally attain to?" Vambéry seems to have returned an evasive reply, though he admits that the query was not altogether irrelevant—at least from the stand-point of an Oriental who values existence for its own sake. But, even in the less unpretending West, longevity is not a bad criterion of happiness. Misfortune kills; nature takes care to shorten a life of misery—for reasons of her own, too, for, in a somewhat recondite (but here essential) sense, the survival of the happiest is also the survival of the fittest. The progress of knowledge tends to circumscribe the realm of accident, and with it the belief in the existence of unmerited evils. In spite of prenatal influences and unprecalculable mishaps, the management of the individual is the most important factor in the sum total of weal or woe. If we could see ourselves as Omniscience sees us, we would probably recognize our worst troubles as the work of our own hands; and we thus recognize them now with sufficient clearness to be half ashamed of them. Most men nowadays dislike to confess their bad luck. We have ceased to ascribe diseases to the malice of capricious demons, and even in Spain the commander of a beaten army would hesitate to plead astrological excuses. Polycrates held that a plucky man can bias the stars, and the popular worship of success may be founded on an instinctive perception of a similar truth. Sultan Achmed went too far in his habit of strangling his defeated pashas, but the world in general agrees with him that there must be something wrong about a generally unsuccessful man. After two or three decided defeats, the partisans of a popular leader will give him up for lost, and after a series of disasters the damaged man himself generally begins to share their opinion and loses heart, or, as the ancients expressed it, admits the decree of fate—that is, his own inability to prevail in the struggle for existence; and it is curious how swiftly a physical collapse often follows upon such a giving way of the moral supports. The storms of every political, social and financial crisis extinguish hundreds of life-flames; lost hope is a fatal (though a silent and sometimes an unconfessed and unsuspected) disease. Good luck, on the other hand, tends to prolong life; the longevity of pensioners and sinecurists is almost proverbial, and there are men who continue to live in defiance of all biological probabilities, merely because existence somehow or other has become desirable, as a liberal supply of external oxygen will nourish a lamp in default of the inner oil. At the beginning of the Franco-Prussian war, King William and his chancellor and staff-officers were already gray-headed veterans, and it is no accident that they are all alive yet; while nearly all the ministers and marshals of the exploded empire have followed their leader—"weary of life and tired of buttoning and unbottoning," as a captain of H. M. S. explained his suicide.

The Evil Effects of Iced Water.

One of the most able and famous of French writers on health subjects, recently remarked in an interview: "I have heard that you Americans are a people lacking in physical health and power. This is untrue. No people on earth are stronger! It must be so, for you drink iced water and *live!* It would kill me, or anybody else but an American."

The point to be remembered is this: The normal temperature of the stomach is not far from 99°, while the temperature of iced water is probably 39° or 40°. Here, then, we take suddenly into that center of the body and of the nervous system (for the stomach is only second to the brain and ganglia as a nervous center) an ice-cold fluid 60° colder than the circulation and the digesting organ into which it is so unceremoniously plunged! What a shock! Is it to be wondered that its effect is often fatal?—that if it does not kill at once, like a bullet, it frequently produces dyspepsia, and other causes of chronic ill health resulting in death.

How may I Possess a Home?

To this important question, we reply, By paying the price of it.

Why do not more of our working-people own the houses in which they make their homes? The answer, in most cases, is, that they do not choose to buy them and pay for them. It is not because they cannot, but because they will not, in the majority of cases.

He who will deny himself the demands of an unreasonable appetite or a vitiated taste, has brought himself at least in the line of promotion toward a home of his own. The excess of wages or earnings of the industrious above the actual demands of life, will in ten years realize a sum equal to the purchase of a domicile as good as that in which the average worker makes his home. If any one wishes to enter upon so perilous an undertaking as home-winning, we will make some suggestions.

First, buy a very cheap place on credit. This you can always do, if you have character for industry and integrity. If you have not these, then get them by right doing, which will require only two years. Make an estimate of ordinary expenses for pleasure, riding, theater and concert-going, cigars and tobacco, drinks (other than water and milk), table expenses beyond actual demands of the physical system, and all such clothing as is not in harmony with a rented house. Add these sums together and make the amount the basis for that of your payments on the property. Move into it, be a king, greet the queen of home on her own threshold when you return from your toil. Say "our house," talk about raising money to pay taxes, plant a tree and a rosebush and a vine, watch them grow as you never did before. Your wages will be advanced at an early date. Employers will say, "we can rely on him.' There is an inspiration in honest ownership.

Warming Houses by the Sun's Rays.

Prof. E. S. Morse, of the Essex Institute, has devised an ingenious arrangement for utilizing the heat in the sun's rays in warming our houses. His invention consists of a surface of blackened slate under glass, fixed to the sunny side or sides of a house, with vents in the walls so arranged that the cold air of a room is let out at the bottom of the slate and forced in again at the top by the ascending heated column between the slate and the glass. The out-door air can be admitted also if desirable. The thing is so simple, and apparently self-evident, that one only wonders that it has not always been in use. Its entire practicableness is demonstrated in the heating of the professor's study in his cottage at Salem. The value of the improvement for daily warming buildings like churches and school-houses, which, when allowed to get cold between using, consume immense quantities of heat before they are fairly warmed again, is evident. Of course some other means of heating must be available when the sun does not shine.

FOR CLEANING SILVER or silver-plated ware, it is affirmed that a solution of hyposulphite of soda is one of the simplest and best applications. The solution may be applied with a rag or soft brush. This method is free from the objection attending the use of powders, as there is no filling up of the fine lines or other ornamental work.

Miscellaneous and Advertising.

The Knowles Pump Works, of this city and Boston, are building a steam cylinder for the Omaha water works, which will weigh 29 tons.

The George Place Machinery Company, of 121 Chambers street, this city, have always on hand a large line of new and second-hand machinery of every description.

"How to Keep Boilers Clean," and other valuable information for steam users and engineers. Book published by James F. Hotchkiss, 84 John street, New York. Mailed free to any address. (Mention this paper.)

The Para Rubber Co., of Framinghouse, Mass., have adopted the Curtis pressure regulator, manufactured by the Curtis Regulator Co., 54 Beverly street, Boston, for their hoisting apparatus, drying rooms and steam pumps.

The Stilwell & Bierce Manufacturing Co., of Dayton, Ohio, is now filling, or has just completed, the following orders for various sizes of its Victor turbine: Five for the Sebago Wood Board Co., of Portland, Me.; one for the Mount Holly Paper Co., of Mount Holly Springs, Pa.; one for the Manlius Paper Co., of Manlius, N. Y.; three for W. Priest, of Kankanka, Wis.; three for the Merriton Cotton Mill Co., of Ontario; one for the Springdale Paper Co., of Springfield, Mass.; five for the Patten Paper Co., of Nunah, Wis.; two for Sidney Brown, of Ogdensburg, N. Y.; and one for the Ottawa File Works, at Ottawa, Ill. A brick works in Devonshire, England, has also ordered a Victor turbine.

The Pulsometer Steam Pump Co., of New York, Boston and Chicago, have recently filled a telegraphic order from Portland, Oregon, for three of their largest New Pulsometer steam pumps, for use on the Nortern Pacific Railroad; also one from California, for a 130,000-gallon per hour pump; and one from Denver, Colo., for a large one to be shipped by express. This company is in daily receipt of telegrams for pumps. They have recently shipped several to South America and Mexico for irrigating purposes, and are now filling an order for six from Cuba for plantation sugar-house pumping. Their business is increasing 100 per cent every three months, which necessitates a constant increase of manufacturing facilities.

Design for a Double Cottage.

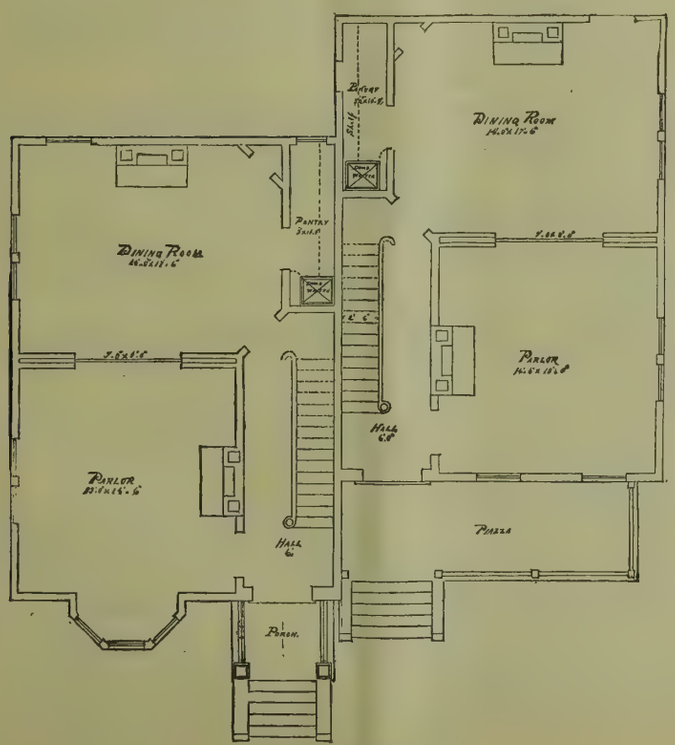
Our architectural illustration this month is for a double cottage, intended for occupation by two families. The whole structure is so arranged as to look like one building, thus making quite a pretentious villa, being a decided improvement on the plan of building two alike side by side, and also being somewhat cheaper than building two separate ones. Building village houses in pairs has not only an advantage in cost, but secures more room on the usually somewhat limited lots, and a better appearance generally, consequently enhancing the value of the property. Three houses can be arranged together also with advantage.

The arrangement of the apartments, which is a very convenient one, is so well shown on the plans that explanation is unnecessary.

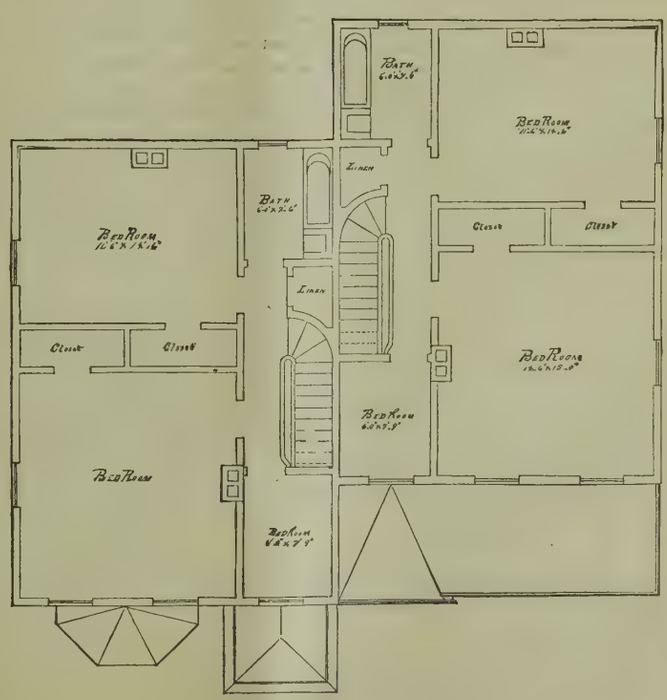
The estimated cost of erection of this twin cottage is about $5,000. It can be built, if desired, at a less cost. The same house, thoroughly built in a good locality, would be a desirable residence for a prosperous merchant.

The plan is by J. A. Wood, architect, of 240 Broadway, this city, the architect of E. B. Sutton's park and cottages at Babylon, L. I., and deer range at Islip, where one of the most complete farm houses in the country is just being completed.

DESIGN FOR A DOUBLE COTTAGE, COSTING $5,000.



First-Floor Plan.



Second-Floor Plan.

Measurement of Water.

The unit that should be used in all measurements of water, is a cubic foot of water passing in one minute. Any other measure of quantity in any other period of time might be used, but it is necessary in all practical calculations that this unit be definite. The measure designated as inches of water, used at the head of wheel tables, is derived from the cubic feet measurements in the tables. This term "inch" means a square inch of cross-section area of a column of water passing with a velocity due to the head theoretically; hence, being only a portion of measurement subject to velocity to make it complete, it is equally applicable to any velocity or head.

A square inch of water under 4 feet of head means 6.7 cubic feet discharged each minute. A square inch of water under 16 feet head means 13.4 cubic feet discharged each minute. When several parties are entitled to draw from a common source, and their rights are described as so many square inches, there are found just as many causes of dispute and litigation as there are different circumstances connected with using the water. When these rights are described as so many cubic feet in a given time, the measurement is definite, capable of being accurately determined, and each party is entitled to make the most of his rights, wronging no one by so doing.

The quantity of water in a stream, and the power to be derived from it, may be measured with approximate accuracy in the following manner: Select a section of the channel where the current is tolerably uniform for a distance of, say 100 feet; first, find the area of the stream by multiplying the width in feet, by the average depth in feet, as follows: We have a stream, the width of which at the section selected is 15 feet. To find the average depth, we divide the width into five equal parts by a cord or tape stretched across; measuring in the center of each of these five divisions, we find the depth of water from bottom to surface to be 9 inches, 12 inches, 18 inches, 14 inches, and 7 inches; adding these together, we get as the sum of measurements, 60 inches, which, divided by 5, gives an average depth of 1 foot; this multiplied by the width—15 feet—gives an area of 15 square feet. To find the velocity, stretch two lines across the stream near the surface, say 80 feet apart; place a float (a small, thin piece of wood) in the center of the stream, or where the velocity appears to be greatest, a few feet above the upper line, that it may acquire the velocity of the water before passing the line. Note carefully the time it is passing from one line to the other. Suppose we find this to be 32 seconds—that is, the velocity of the water is 80 feet in 32 seconds; in one minute, therefore, it would be 80×60 divided by $32=150$ feet. This is the most rapid portion of the stream at the surface; at the bottom and sides the velocity is so much less that it is found that the mean velocity for the whole area is about 84 per cent of this maximum velocity. In this case the mean would be $150\times84=126$ feet per minute. Hence, the stream furnishes $126\times15=1,890$ cubic feet of water per minute.

We find by the level that there is a fall of 8½ feet in the channel of the stream. Allowing 6 inches for fall due velocity of supply and discharge, we have 8 feet effective head at the wheel. A cubic foot of water, weighing 62.4-10 pounds nearly, we have $1,890\times62.4=117,936$ pounds of water per minute; this, multiplied by the fall (8 feet), gives 943,488 foot-pounds per minute, which, divided by 33,000, equals 28.59 horse-power. This is the full theoretical power due the supply of water and head.

OVER FIVE THOUSAND ELECTRIC LIGHTS IN ONE BUILDING.—The Mills building, at Wall and Broad streets, this city, has been wired for 5,588 Edison lamps. As this is the largest enterprise of the kind ever undertaken, the details may prove interesting. The conductors consist of 1,650 feet of Edison's patent electric tubes, 628 feet of lead pipe containing tapped wires thoroughly insulated, 23,658 feet of zinc tubes, 75,909 feet of wire conductors, and 24,162 feet of wooded receptacles, placed between the floors to hold the system of distributed wires. The total amount of wires used was 3,774 pounds, besides 48 vertical main cut-outs and 253 division cut-outs. The work was done by the wiring department of the Edison Illuminating Company of New York, under contract with D. O. Mills, the owner of the building.

CORRESPONDENCE.

The Lawson "Diaphragm" and Experiments Criticised.

TO THE EDITOR OF THE MANUFACTURER AND BUILDER:

Observing your notice and recommendation of D. T. Lawson's late experiments on the cause and remedy of boiler explosions going the rounds of the newspapers, I have taken the liberty of sending three copies of the *Railway Age*, with some correspondence of my own on the subject, and with Mr. Lawson, on what I regard as errors asserted by him and his friends.

My object is truth, without regard to favor, and therefore ask your perusal of the correspondence, and such criticism as you may deem just. Lawson claims that his diaphragm prevents explosion, by separating the water from the steam, yet the diaphragm, rising *in a circle* from the water, leaves a large amount of *dangerous* space between the top of the water and the diaphragm in its center, and liable to all of the same contingencies of explosion as if the diaphragm was not present. Again, he claims that in his late experiment, that with his diaphragm, etc., it stood 300 pounds pressure, yet, on cutting some out, the boiler exploded at 235 pounds; and he claims that these facts demonstrate his theory as correct, and ignores the fact that one great merit of his diaphragm is, increasing the strength of the boiler; and yet he loses sight of this fact when he proceeds to cut it out, and because, *when thus weakened*, and with the previous strains, it burst with 235 pounds pressure instead of 300 pounds, he claims that the explosion was not due to the weakening of the boiler by cutting out the diaphragm, but was due entirely to the removal of his contrivances for *suppressing* the water.

Mr. Lawson and his friends *prove too much*, and a little reviewing will do them good.

I see that Mr. Lawson, by a free use of money, is having the stereotyped description of his experiments published and eulogized all over the land, and doubtless by such claptrap will soon have organized another millionaire company, like the famous Keely motor concern, with like results. But I predict that all of the Lawson boilers will prove more dangerous than the common boilers, for the reason that his apparatus will tend to increase the present danger.

Respectfully, JOHN MCMURTRY.

Lexington, Ky., August 2, 1882.

New Publications.

Cheap Dwellings. A Series of Neat and Comfortable City and Country Residences Illustrated and Described by Carefully Prepared Plans and Specifications, and accompanied by Reliable Estimates of Cost. Published by the San Francisco Bulletin Co. 1882.

The above comprises a series of twelve plans, with detailed specifications, both as to materials and cost, of town and country houses, ranging in cost from $500 to $5,000. They were originally published in the San Francisco *Evening Bulletin*, to meet the very evident wants of a large portion of the growing community of that city and neighborhood for examples of buildings of moderate size and cost, of tasteful design and appearance, and with convenient interiors. The plans here referred to were prepared with great care, and with the view of meeting this want, by John C. Pelton, Jr., a well-known architect of San Francisco. They met with so much favor that the editions of the *Bulletin* containing them soon became exhausted, and the plan of a separate publication was decided upon. In this form they come to us. The mechanical execution of the letter-press and of the plates is in keeping with the excellence of the designs, and reflect much credit on the enterprise of our San Francisco contemporary.

Taxidermy without a Teacher; Comprising a complete Manual of Instruction for Preparing and Preserving Birds, Animals and Fishes, with a Chapter on Hunting and Hygiene; Instructions for Preserving Eggs and Making Skeletons, and a Number of Valuable Receipts. By Walter P. Manton. Illustrated. Second edition, revised and enlarged. Boston: Lee & Shepard; New York: Charles T. Dillingham. 1882. Price, 50 cents.

In this very practical and handy little manual the author gives, in a series of chapters, much useful information that the amateur naturalist will find valuable in advancing him in the practical side of his studies. The author gives plain instructions for skinning and mounting birds and the making of perches; the skinning and mounting of mammals; the skinning and mounting of fishes and reptiles; the collection and preservation of eggs and nests; the preparation and mounting of skeletons; and a final chapter giving some sensible hints on hunting and hygiene, including such matters as the choice and care of the gun, caring for and transporitng material collected, clothing, personal habits, etc.

The Chemistry of Cooking and Cleaning. A Manual for Housekeepers. By Ellen H. Richards, Instructor in Chemistry, Women's Laboratory, Massachusetts Institute of Technology. Boston: Estes & Lauriat. 1882.

There is something very appropriate in a woman teacher of chemistry to women, instructing the great sisterhood beyond the school in such important, though generally despised, things as the chemical mysteries of cooking and cleaning. It is only a pity that this species of domestic education is not more generally sought after or better appreciated; for the lack of it is responsible for the general prevalence of badly prepared food and its attendant evils, and the general extravagance and wastefulness that is the rule in many families who can illy afford to pay such penalty for ignorance. For these reasons, we welcome this admirably written little volume, and in speeding it on its mission we trust its influence will be commensurate with its deserts.

Drinks, Drinkers and Drinking; or, The Law and History of Intoxicating Liquors. By R. Vashon Rogers, Jr., of Osgood Hall, Barrister-at-Law. Albany: Weed, Parsons & Co. 1881.

The author of this volume has presented in moderate space a very interesting and important phase of the subject of intemperance—namely, the history and laws relating to intoxicating drinks. It covers a ground, so far as we know, that no author has endeavored exactly to cover before, and the information conveyed in the chapters on definitions, contracts, deeds, wills, insurance, marriage, rights, crimes and statute laws is of as much importance to the layman as to the professional reader. The author has evidently made extended research in the preparation of his book, and gives his references to authors and judges who have written or made decisions on the subjects treated of, so that his readers may refer to them for verification or further research. The book, aside from the information it contains, makes most interesting reading.

American Silk and Fruit Culturist. Campbell & Pepper, 1328 Chestnut street, Philadelphia. Yearly subscription, $1. Monthly. July, 1882. Vol. I., No. 1.

The above journal is a newly started monthly magazine, devoted to the encouragement and furtherance of silk culture in the United States, and incidently to fruit culture. It has the support and countenance of the Women's Silk Culture Association. We heartily sympathize with the work and wish the new aspirant for journalistic honors much success. The first number presents a handsome appearance, and is very readable.

The Standard Molding Book, (Revised). A Catalogue of Moldings, Brackets, Architraves, Balusters, Newel Posts, Pew Ends, Stair Railings, etc.; with New and Improved Designs for Doors, Door Frames, Windows, Store Fronts, Elevations, etc. Arranged by W. B. Judson, Editor of the "Northwestern Lumberman." Chicago: The Lumberman Publishing Co. 1882.

The above pamphlet embraces 110 large octavo pages of well-executed plates, embracing every standard form of decorative wood-work used in house construction. The manual will be found useful to architects and builders.

Synopsis of Fresh-Water Rhizopods. Compiled by Romyn Hitchcock. Published by the Author, 53 Maiden Lane, New York. 1882.

The above work gives a condensed account of the interesting microscopic forms of fresh-water life, so admirably described by Prof. Leidy in his great work on the subject. Mr. Hitchcock has done good service in his effort to place a history of these little-known organisms at the service of microscopists, in convenient form.

OTHER PUBLICATIONS RECEIVED.

Annual Report of the Chief Engineers to the Secretary of War, 1881. Washington Government Print. 1881. From the Chief of Engineers.

The Death Rate of Memphis. By Geo. E. Waring, Jr. Reprint from the "American Architect" of March 25, 1882. From the publishers.

Condensed Treatise on the Manufacture of Sugar from the Beet Root, as well as from Sorghum and Cornstalks. By Maurice M. Monsanto. From L. S. Ware, Philadelphia.

Dickinson College Centennial Commemoration, 1883. From Prof. C. F. Himes, Carlisle, Pa.

Physiological Perspective. By W. Le Conte Stevens. Re-

print from the "Philosophical Magazine," May, 1882. From the author.

"The Verdict March" and "Little Playmates." Two pieces of instrumental music. Published by F. H. Helmick, 180 Elm street, Cincinnati, O.

Announcement of the Pennsylvania State Normal School, at Edinboro, Erie county, Pa.

The Constitutional and Legal Aspect of the Mormon Question. Speech of James W. Stillman, in Science Hall, Boston, Mass., April 2, 1882.

Report of the New Jersey State Commission, appointed to devise a Plan for the Encouragement of Manufactures of Ornamental and Textile Fabrics, 1878. Trenton: State Print. 1878. From B. F. Pierce, Camden, N. J.

This department is intended to furnish, for the benefit of all our readers, information on any subject of a scientific or technical character falling within the field of THE MANUFACTURER AND BUILDER. *Any of our readers possessing additional or more correct information than that which we give relating to the questions, are cordially invited to communicate it to us for publication. We also request that all questions or answers be written on separate pieces of paper, and addressed to the Editor.*

QUESTIONS.

(3061) SUPERIORITY OF OLD MORTARS.—In your issue of July, 1880, in the department of "Notes and Queries," I observe that you speak of the formation of silicate of lime as giving strength to mortars. I have always thought, and think the books say, that the hardening of lime mortar is due to the absorption of carbonic acid and the formation of carbonate of lime. Will you please explain your statement more fully.—H. C. C., Vandalia, Ill.

(3062) DESTRUCTION OF OIL TANKS BY LIGHTNING.—What is the cause of the peculiar liability of oil tanks to be struck by lightning? It is a very common occurrence in the oil country.—J. C. McD., Titusville, Pa.

(3063) USES OF BISMUTH.—What are the uses of bismuth in the arts? Is there much demand for it? Where does the chief supply of the metal come from?—P. W. A., Salt Lake City, U. T.

(3064) WEATHER WASTE OF COAL.—Does soft coal suffer loss of its heating qualities by being exposed to the weather?—J. McM., Cleveland, O.

(3065) BLUE PRINTS.—Will you please give a description of the process of making blue prints that is used in many shops for duplicating drawings.—E.E., Berwick, Me.

(3066) SPONTANEOUS COMBUSTION.—We often read in the papers of fires caused by spontaneous combustion. Do you believe this is correct?—T. W., St. Louis, Mo.

(3067) SULPHUROUS ACID.—How is sulphurous acid manufactured commercially? Please give, also, a list of the uses to which it is put, and oblige.—A. P., Providence, R. I.

(3068) AREA OF SAFETY VALVES.—What is the best rule for the area of safety valves for boilers?—T. R. W., Austin, Tex.

(3069) RAILWAY SPEED IN ENGLAND.—What is the quickest railway run of any length made on an English railway? The English, I am told, have the reputation of making the best time on their roads.—L. L. C., Trenton, N. J.

(3070) BENDING COPPER TUBES.—How can I bend a number of copper tubes without showing wrinkles or ribs? How do coppersmiths do this sort of work?—W. L. J., Bellefonte, Pa.

(3071) SMOKING MEAT.—Will you explain how it is that smoking cures or preserves meat.—A. P. B., Charlotteville, N. C.

(3072) QUANTITY OF WATER REQUIRED IN CITIES.—What is the estimate usually given by water-works engineers in fixing the supply per head of population?—C. H. B., New Market, Va.

(3073) TIMBER FOR SPOOLS.—What kinds of trees are worked into spool stuff? How is it cut for market? and where is there a sale for the same?—E. O. F., Washington, D. C.

(3074) UTILIZING TIMBER.—Where could I obtain the most reliable information as to how to prepare for market the different varieties of trees occurring in a tract of 1,800 acres of Virginia yellow pine land?—E. O. F., Washington, D. C.

(3075) TO CEMENT MARBLE.—Can you give a better cement than plaster of Paris for stopping the seams in marble wash-basins and slabs where they are constantly wet? Plaster of Paris will last only about three weeks in my establishment.—A SUBSCRIBER, New York City.

(3076) ENAMELED BRICKS.—In your August number, in answer to query 3054, you refer to a Pittsburgh inventor as having succeeded in producing an enamel for bricks that will not craze. Can you give me his name and address, or a formula for a good enamel for the purpose?—A. B. C., Cobleskill, N. Y.

(3077) THREE-HIGH CIRCULAR SAW MILLS.—Is there such a thing as a saw mill having three circular saws, one above the other? If so, how does the arbor of the middle saw get through the board?—F. H. T., Philadelphia.

(3078) LUMBER TRADE'S JOURNAL.—Can you give me any information regarding the *Lumber Trade's Journal*, whether there is such a journal published or not, and where the publication office is? Will you please give me such information at your earliest convenience, and greatly oblige an old subscriber.—I. A. S., Providence, R. I.

(3079) INVENTOR OF THE SLIDE RULE.—Who invented the slide rule? and when? Hodgson says it was Everard? Kentish, in his "Treatise on a Box of Instruments," states that it was Partridge.—F. H. T., Philadelphia.

(3080) NEW ELEMENTS.—I noticed some time ago in your valuable journal a number of accounts of the discovery of new elements. Can you tell me if these alleged discoveries have all been found to be valid? or, if not, which have been disputed?—EX-STUDENT COLUMBIA COLLEGE, New York.

(3081) BOILER PROBLEM.—What ought to be the maximum safe working pressure of a single-riveted iron boiler, 40 inches diameter, constructed of ¼-inch plate having a tensile strength of 45,000 pounds per square inch?—W. McD., Syracuse, N. Y.

(3082) CEMENT TO WITHSTAND PETROLEUM.—Can you give me a receipt for a cheap cement that will resist petroleum or benzine?—W. S., Burlington, N. J.

REPLIES.

(3061) SUPERIORITY OF OLD MORTARS.—The question of the setting and hardening of mortars is an interesting one, and in response to this inquiry we shall endeavor to answer it fully and satisfactorily. Ordinary lime mortar consists simply of a mixture of slaked lime of pasty consistency with sand in varying proportions. Its function in construction is that of cementing together the bricks or blocks of masonry composing the walls of the structure, a result which is accomplished after a longer or shorter interval of time, by the gradual hardening of the pasty mixture. The use of sand, or some equivalent granular material, with the lime, is found to be indispensable, since of itself the lime, although it will harden, will not form a mass of sufficient tenacity to cement the bricks or blocks together strongly. The sand largely increases the surface of the lime, and thus, by indefinitely multiplying the number of points of attachment, brings about a much more intimate contact between the surfaces of the building stones or bricks and the lime. In the process of hardening, the free access of the air and the action of moisture are essential. The rate of hardening, though at first very rapid, is thereafter a very gradual one, and a mortar may not attain its maximum hardness for years, or even centuries. It is to this fact that we must ascribe the apparent superiority of ancient mortars—a superiority which, though popularly attributed to a better knowledge of proportions or ingredients, may be explained most satisfactorily by the longer time in which these ancient mortars have been exposed to influences which bring about certain beneficial chemical changes, which changes have had time also to penetrate to every portion of the mass. The cause of the setting of mortar is mainly due to the gradual absorption of atmospheric carbonic acid, the result being the gradual formation of a carbonate of lime. That this is not the only cause of the phenomenon, however, is abundantly proved by the fact that even in the most solid walls the lime in the interior of the mortar is still found, for a considerable time after their erection, in an uncombined or caustic state; and, further, by the fact that any ancient mortar, when treated with muriatic or sulphuric acid, will yield a jelly-like mass, showing that a portion of the lime had been in combination with silica as a silicate. As most of the lime that is burned is more or less impurified from the presence of clay (a silicate of alumina), the inference is warranted that at least a portion of the silica found in combination with the lime of mortars, may have been derived from this source, the silica of the clay having been made soluble by being burned with the lime in the kiln. The results of numerous analyses of mortars of all ages have shown, however, that there is invariably a much larger proportion of silica combined with lime present than would correspond with the alumina present. We are thus forced to conclude that the excess of silica found in these mortars has been obtained from the sand by the gradual action of the lime upon it, aided by the presence of moisture. The correctness of this conclusion is demonstrated by the fact that *the older the mortars* the greater the quantity of the silicate of lime which they contain—a fact that has been repeatedly verified by chemical analysis. The following tabular statement of results of two analyses of mortars will fully illustrate the point in question:

	300 *Years Old.*	100 *Years Old.*
Sand (insoluble in muriatic acid)	69.1 per cent.	79.8 per cent.
Silica (forming a jelly)	6.2 "	2.1 "
Alumina	0.4 "	0.016 "
Iron (ferric oxide)	1.4 "	0.16 "
Lime	4.2 "	4.3 "
Water and carbonic acid	18.7 "	13.6 "
	100.00 "	99.976 "

These analyses, given on the authority of Petzholdt, which may be safely taken as representative, fully substantiate the views we have expressed, inasmuch as the percentage of silicate of lime in the 300 years old mortar is three times as great as that of the sample but 100 years old. While it is true, as this inquirer supposes, and as the books say, that the hardening of lime mortar is due to the absorption of carbonic acid and the formation of carbonate of lime, it is also true that their gradual improvement with age, and consequently the superior strength of ancient mortars, is due to the gradual formation of a silicate of lime—a process which may take centuries to complete.

(3062) DESTRUCTION OF OIL TANKS BY LIGHTNING.—Oil tanks are huge metallic vessels, having ample earth contact, and being good conductors of electricity, are naturally very liable to receive the lightning stroke. To guard against the danger of inflaming the oil stored in the tanks, it is very necessary that the tanks should be rodded, so that the stroke may not be received upon the dome and ignite the oil vapor. To insure protection, however, the method in general use of surrounding the tank with a cordon of rods placed at some little distance from it, is, we are satisfied, a mistake. With this arrangement, the probabilities are very strong that the lightning will descend the rods as far as the highest portion of the tank, where it will leave the rod and fly to the tank by lateral discharges, to the imminent danger of the destruction of its contents by explosion and combustion. It is, in fact, scarcely conceivable that the electric discharge will take place along a system of slender rods when a huge metallic body (the tank), having many thousand times superior attracting and conducting capacity, and a vastly superior ground connection, stands conveniently at hand. The proper method of rodding such tanks is, undoubtedly, to attach a cordon of rods directly to the body of the tank itself, and to let them pass upwards from the bottom, directly against the sides of the tank, and extend upwards for perhaps twenty or thirty feet above the dome. A system of half a dozen such rods uniting above the dome in a single rod, would form part of the tank itself, and would do away with the great danger from the leaping of the spark from the rods to the tank, which is always to be feared where the rods are separated from the tank, as is the general practice. Forming, as they would when connected with the tank, simply a vertical extension of the huge vessel, the tendency to lateral discharges from the cause above indicated, would be guarded against, and the electricity would be harmlessly neutralized by diffusion through the metallic body of the tank.

(3063) USES OF BISMUTH.—Bismuth in the metallic state is chiefly used for the production of alloys. Its oxide, in connection with boracic and silicic acids enters into the composition of some kinds of glass, and is used for porcelain and glass staining. The basic nitrate (*magistrum bismuthi* of the pharmacists), and the carbonate, are used in medicine; and the former, under the name of *Blanc de fard*, and other designations, is used by ladies for painting and beautifying their faces. Among the alloys of bismuth, those with lead, tin and cadmium are the most important. Newton's fusible alloy is composed of bismuth, 8 parts; tin, 3; and lead, 5, and melts at 202° Fah. Rose's fusible metal consists of 2 parts of bismuth, 1 of lead, and 1 of tin, and fuses at 200° Fah. If a small quantity of cadmium be added to these alloys, they become still more easily fusible. An alloy composed of 3 parts of lead, 2 of tin, and 5 of bismuth, fuses at 195° Fah., and may be used for stereotyping purposes, but is rather expensive. This alloy is said to be used for making the pocket-book metallic pencils for writing on paper prepared with bone ash. Alloys of bismuth are also used for safety plugs in steam boilers. Bismuth has been suggested as a desirable addition to lead in the manufacture of lead pipe, giving the last named metal greater hardness. The total annual consumption of bismuth will probably not exceed 10 or 12 tons, though this is simply a guess. The supply of bismuth is obtained chiefly from German sources, and the market for the metal is in the hands of a few German and English houses that control the supply. It is possible that in the event of the opening up of new sources of supply, so that the metal could be produced cheaply, many other new uses for it would be found.

(3064) WEATHER WASTE OF COAL.—The amount of the loss suffered by coal by exposure to the weather is considerable, far greater, in fact, than is generally known. Varrentrapp, who has made this question the subject of an investigation, reports, as the result of numerous analyses, a total loss in weight of a specimen, from this cause, amounting to 33.08 per cent, while its deterioration in quality for purposes of fuel or gas-making reached a still higher figure. The changes carried on in this way are undoubtedly due to a slow combustion, in which the volatile constituents, which are most valuable combustible elements, are gradually eliminated, while the relative proportions of carbon, ash and sulphur are comparatively increased. Anthracite, a highly metamorphosed coal, containing little or none of these volatile elements, suffers comparatively little from this cause. The so-called cannel coals rank next to the anthracite in their power to resist deterioration from the influence of weather. The density and compactness of this variety of coal doubtless aid in protecting it in no inconsiderable degree. The varieties called bituminous are the most susceptible to

weather waste. The experiments of Dr. Varrentrapp are of such direct and practical importance, that all who are engaged in the mining, transportation and storage of coal, may study them with profit. It appears from accurate tests of a number of samples before and after exposure, that the deterioration from exposure to the weather affects all the valuable properties of coal. The coking quality of the weathered coal diminishes with its gas-yielding quality, the author in question informing us that a sample of coal yielding, when freshly mined, a firm, coherent coke; after eleven days exposure, yielded a coke of no coherence; and in all the samples tested the rule was found to hold good, that the longer the coal had been exposed the greater was the inferiority in the quality of the coke it produced. The gas-yielding quality of the coal decreased in one instance as much as 45 per cent, and the heating power 47 per cent, while the same sample under cover lost in the same time only 24 per cent for gas purposes, and 12 per cent for fuel. These experiments indicate the imperative necessity of keeping the bituminous varieties of coal amply protected from the deteriorating action of the weather, by keeping them constantly dry and under cover.

(3065) BLUE PRINTS.—There are a number of processes that go under the name of "blue printing." The one most commonly used by machinists and others to multiply their drawings, is substantially as follows: A piece of unsized white paper is taken and made sensitive by means of a chemical wash, consisting of 1¼ ounces of ferro-cyanide of potassium, commonly known as red prussiate of potash, and 1⅜ ounces of citrate of iron and ammonia, dissolved in 16 ounces of water. This, when applied to the paper in a dark room, by means of a large and soft brush, imparts to the paper when dry a peculiarly rich, glistening, yellow surface. This paper when dry is ready for printing. If at this stage a fern leaf is taken, or a few sprigs of grass, or a feather, or any drawing executed on translucent material, such as common tracing paper, it may be perfectly copied in every minute detail within the space of four or five minutes. The object is simply laid on the paper and a piece of glass put over it to hold it in position, and then exposed to direct sunlight. The yellow paper then turns rapidly to a dull blue, then to a light gray, whereupon, at the expiration of about three minutes, it is withdrawn. But one thing remains to be done—the sensitive paper is given a bath of pure water, and a perfect copy of the fern leaf, grass or drawing remains behind on the blue surface of the paper, in white, as if traced by hand. The philosophy of the process is that the black lines of the drawing or the filaments of the grass or fern are opaque, and consequently refuse admittance to the light, which operates upon the open, sensitive spaces, causing them to undergo a chemical change. As utilized by railroads, iron companies, ship-builders and architects and artists, however, in multiplying their many maps and plans, and even circular letters, the process becomes a little more complicated. Instead of merely placing the design to be printed over the sensitive sheet and leaving the rest to the light, large glass printing frames, such as are employed by photographers, are used, inside of which the drawing is placed, face downward, and covered with the sensitive paper. The frame is then locked by folding down a pair of hinged doors on the back, which holds the transparent drawing and the sensitive paper in close contact, and leaves the plan exposed to the light. A full bright sun is not absolutely requisite, but a longer time is required for exposure on a cloudy day.

(3066) SPONTANEOUS COMBUSTION.—We are of opinion that the term "spontaneous combustion" is used much too freely. It affords a very convenient way of accounting for the occurrence of many fires where the cause is enveloped in mystery, and is no doubt made responsible for many cases of incendiarism. On the other hand, there can be no question that there is such a thing as spontaneous combustion—that is to say, ignition, caused by a species of slow combustion, which takes place with certain substances when exposed to favorable conditions; by the accidental contact of two or more substances capable of acting chemically on each other; or by the decomposition of explosive substances Many cases falling in one or the other of these classes have been investigated, and proved to be genuine. The commonest cases of this kind are such as are caused by the property, possessed by certain oily substances, of absorbing oxygen. This is especially true of linseed oil, which is largely employed for making oil paint. During the process of drying, the oil absorbs oxygen in considerable quantity, and where such porous substances as wool, tow, cotton, cotton waste, rags and the like, become saturated with such oils, there is liability to spontaneous combustion. This is especially to be apprehended when these substances are located in a confined space, or packed closely together, so that the heat which is generated by slow oxidation cannot be dissipated as rapidly as it is generated. The specific form of spontaneous combustion that is of most common occurrence is the ignition of oily cotton waste, used for wiping off superfluous oil from machinery in workshops, factories, mills, etc. This is recognized by all intelligent owners of mills, etc., as an ever-present danger, and the disposition of such refuse stuff is carefully looked after. Some varieties of bituminous coal, especially such kinds as contain much pyrites, are liable to spontaneous ignition from the oxidation and heating of this mineral. Many cases of this kind are on record, and many vessels transporting coal of this character have been burned at sea from this cause. We might name many other forms of spontaneous combustion, but the above are sufficient to establish the genuineness of the phenomenon.

(3067) SULPHUROUS ACID.—Sulphurous acid may be prepared on a large scale either by the direct combustion of sulphur in a slow current of air, or by roasting or calcining iron and copper pyrites, or by the action of sulphuric acid on certain metals, as, for example, copper. The gas evolved may be collected either by absorption in water, or by absorption in lime water, whereby a sulphite of lime is produced. From the latter the acid may be evolved by treatment with sulphuric or hydrochloric acid. The gas may be condensed to the liquid state by very moderate pressure (about 3 atmospheres), and stored in closed lead-lined reservoirs. Sulphurous acid (*vide* "Wagner's Hand-book") is chiefly employed in preparing sulphuric acid, in the manufacture of paper as so-called anti-chlorine, in the preparation of madder (E. Kopp's process), and in the preparation of hyposulphite of soda. It is also employed in certain metallurgical processes, for preserving food, for bleaching syrups, silk, wool, sponges, feathers, glue, isinglass, and for bleaching straw hats, willow and wicker baskets, gum arabic, etc. Of late it has come to be used to some extent in refrigerating machines for the production of artificial ice.

(3068) AREA OF SAFETY VALVES.—Safety valves should always be large enough to permit the escape of all the steam a boiler is capable of making. The following rule, according to Barr, is that enforced by the United States government in fixing the area of safety valves for the boilers of ocean and river vessels, when the ordinary lever and weight safety valve is employed. *Rule.*—When the common safety valve is employed, it shall have an area of not less than one square inch for each two feet of grate surface. The following rule has been prepared by Prof. Thurston: Multiply the pounds of coal burned per hour by 4, and divide this product by the steam pressure, to which the constant number 10 is added. *Example.*—What would be the proper area for a safety valve for a boiler having a grate surface of 5 feet square, and burning 12 pounds of coal per hour per square foot of grate, the steam pressure being 75 pounds per square inch? $5 \times 5 = 25$ square feet of grate surface; $12 \times 25 = 300$ pounds of coal per hour; $300 \times 4 = 1{,}200$; 75 pounds steam pressure $+ 10 = 85$; then $1{,}200 \div 85 = 14.11$ inches area of safety valve=nearly 4¼ inches diameter.

(3069) RAILWAY SPEED IN ENGLAND.—We have given in former issues of the MANUFACTURER AND BUILDER a number of facts relating to speed on railways in England and in this country, to which we refer this inquirer for general information. He is correct in supposing that the English make better time on their roads than is done in any other country, though we have roads (as, for example, the Pennsylvania, New York division) on which as high a rate of speed is maintained as on the best of the English roads. As for the best record on an English railway, we do not have much at the present writing to refer to, but can give the following on the authority of the London *Engineer*, a journal of high standing. The journal in question gives the following performance of a train on the Great Northern Railway, and pronounces it to be the quickest run of the stated length on record, namely: A Great Northern train, with an 8-foot single driver, outside side cylinder engine, which recently took the Duke of Edinburgh from Leeds to London, made the journey of 186¾ miles in exactly 3 hours. One stop was made at Grantham. The actual speed was, therefore, over 62 miles per hour.

(3070) BENDING COPPER TUBES.—For bending copper tubes, the almost universal practice, so far as we can learn, is to fill the tubes with lead or rosin, then turn a groove in a chuck of the same radius as that required for the bend, and bend the tubes around this. The lead or rosin may then be melted out. Mr. M. L. Orum, a machinist of Philadelphia, some years ago devised an ingenious apparatus for this purpose, which we are somewhat surprised to find has not come into general use. It consists of a flexible mandrel of steel, made of wire of square cross-section, and with the coils lying in contact so as to form a close spiral. By inserting one of these of the right diameter into the tube, it can be bent to any angle without showing the slightest symptom of wrinkling; when properly bent, the mandrel can be readily withdrawn by simply taking hold of one end of it and drawing on it, giving it at the same time a slight twist to lessen its diameter. At the time Mr. Orum's invention was first brought out, it was very well spoken of, but of late we have lost sight of it. It certainly answered its purpose very well.

(3071) SMOKING MEAT.—We do not understand fully the *rationale* of the curing of meat by the preservative action of smoke. Wagner gives the following explanations, which are as satisfactory as our knowledge of the subject will permit. In the first place, he states, the heat of the smoke dries the meat, while, further, smoke contains a creosote. This creosote possesses the property of coagulating the albuminous substances of meat, and once coagulated, and thereby rendered insoluble, these substances are not capable of decay, or only so after a great lapse of time. Smoke, moreover, contains some pyroligneous acid, and other creosote-like substances (oxyphenic and carbolic acids), which undoubtedly play an important part in this preservative action.

(3072) QUANTITY OF WATER REQUIRED IN CITIES.—Trautwine gives the following points bearing on this inquiry. He says the quantity of water required in cities has been found to increase faster than the population; about 60 gallons, or 8 cubic feet per day to each inhabitant, is usually considered a fair, ample allowance. Many European cities have not half as much, while New York and some other cities use and waste half as much more. With efficient means for preventing waste, 60 gallons would probably suffice for any commercial city; but inasmuch as cleanliness and health are promoted by its free use, as few restrictions as possible should be introduced.

(3073) TIMBER FOR SPOOLS.—So far as we are advised, the wood of the white birch is preferred for making spools to anything else. It is unfit or inferior for nearly every other use, but for this one it is well adapted. The wood is worked up at the factories, and can no doubt be delivered in the log without any previous preparation. At the factory the wood is sawed into pieces about 4 feet long and from 1 to 1½ inches square, according to the size of the spool. These are then dried in the dry-house, and worked up into spools by special machinery. The only place we know of in this country where spools are made on the large scale is at Drummondville, Canada, where there are several large factories turning out a very large product, much of which is shipped abroad. There are, no doubt, numerous factories in the United States, the location of which this inquirer can ascertain by corresponding with some of the large thread manufacturers. We may be able to obtain some additional addresses in time for our next issue.

(3074) UTILIZING TIMBER—The lumber dealers, it appears to us, would be the most competent to give this inquirer the information he seeks for respecting the preparation of timber for the market.

(3075) TO CEMENT MARBLE.—A cement that is highly recommended for joining marble or alabaster, is made as follows: Add ½ pint of vinegar to ½ pint of skimmed milk, drain off the liquor from the precipitated curd, and mix into it thoroughly the whites of 5 eggs well beaten, and sift in enough powdered quicklime (not slaked) to form a stiff, homogeneous paste; then apply to the seams to be stopped. This cement is said to harden rapidly, and to resist water successfully, though it will not stand much heat. A much stronger cement than this, if the color is not objectionable, can be made in the following manner: Take of litharge and red lead equal parts, mix thoroughly, and work into a paste with glycerine (concentrated) to the consistency of soft putty; fill the seam with this. This cement takes some little time to dry, but sets almost as hard as stone, and is water and fire proof. When once hardened, it is easier to break the stone than the joint.

(3076) ENAMELED BRICKS.—We are not in possession of the name of the inventor of the process of enameling bricks referred to in our answer to query 3054; but the company manufacturing them on the large scale is called the Brick Enameling Company, address 140 South 4th street, Philadelphia. They will, doubtless, answer any inquiries.

(3077) THREE-HIGH CIRCULAR SAW MILLS.—Such mills are in use, although not common, on the Pacific coast, cutting logs from 9 to 10 feet thick. You will find clear drawings of them on pages 246 and 247 of "Grimshaw on Saws," with sufficient explanation.

(3078) LUMBER TRADE'S JOURNAL.—There are several trade journals devoted to the lumber interest. The best of these is the *Northwestern Lumberman*, published by the Lumberman's Publishing Co., 154 Lake street, Chicago. There is also an excellent lumber paper published at Bay City, Mich., called the *Lumberman's Gazette*.

(3079) INVENTOR OF THE SLIDE RULE.—We cannot decide this question. If any of our readers are posted on the subject, we would be pleased to hear from them.

(3080) NEW ELEMENTS.—The chemical journals a few years ago announced the alleged discovery of a large number of new elements, but it is more than likely that a careful *resumé* of the work of so many investigators will show that some of these have made premature announcements, and that others have gone over the same ground, and, as a result, have described the same elements under different names. It is yet too early to say with any degree of assurance, which, and how many, of these alleged discoveries are genuine. To do this will require a careful *resumé* and comparison of the work of many investigators.

(3081) BOILER PROBLEM.—Such a boiler as the one described, if constructed in a workmanlike manner, should withstand a pressure of 500 pounds per square inch before rupturing, and could be worked with safety at one-sixth of its total strength—say at a maximum of 90 pounds pressure.

(3082) CEMENT TO WITHSTAND PETROLEUM.—Gelatine (glue) mixed with glycerine forms a compound which can be liquefied by heating, but which solidifies on cooling, and forms a tough, elastic solution, having somewhat the appearance and character of india rubber. This compound is entirely insoluble in petroleum or benzine, and any vessel coated or painted with it becomes impervious to these liquids.

THE MANUFACTURER AND BUILDER,

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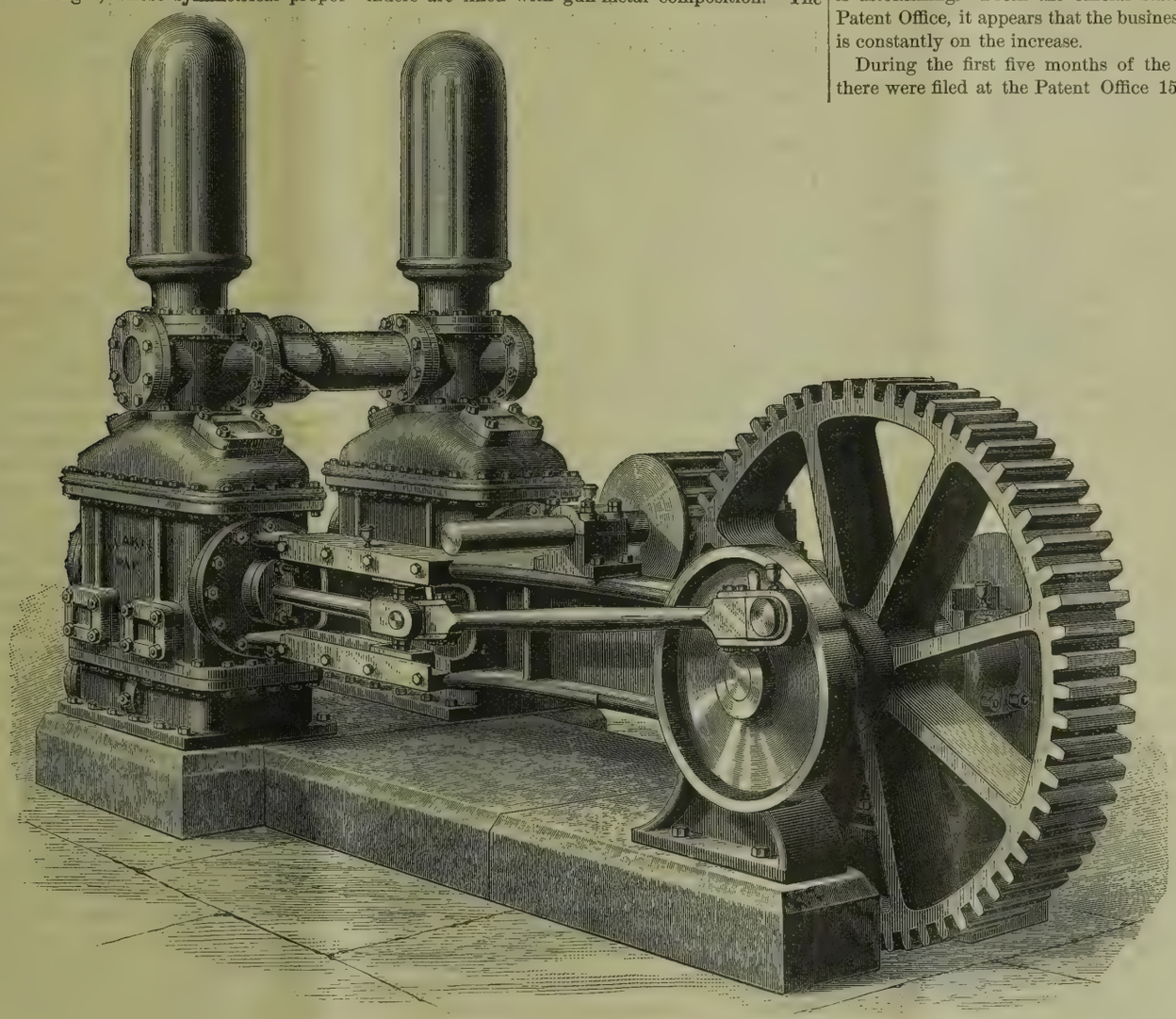
Vol. XIV.—No. 10. OCTOBER, 1882. Fourteenth Year.

Blake's Improved Duplex Power Pump.

We present herewith a perspective elevation of a duplex power pump, built by the George F. Blake Manufacturing Co., of New York and Boston, for the Cañon City water works, Cañon City, Colorado. Nothing need scarcely be said of the appearance of the pump illustrated, for the engravings shows a machine of great strength, whose symmetrical proportions suggest durability and permanence of duty, desiderata in great demand for water works service. The pump has 14-inch cylinders and 24-inch stroke, and is rated at 2,000,000 gallons per diem. It is actually pumping against a vertical head of 350 feet, the power to drive this being a 71-inch turbine water-wheel.



BLAKE'S IMPROVED DUPLEX POWER PUMP.

The heavy frame and powerful spur wheel and gearing are of cast iron. The cranks are set at right angles, which brings one pump to the middle while the other is at the end of the stroke. This arrangement assures a constant, steady flow of water with the minimum variation of pressure. There is no shock or jar while pumping. The suction valves are below, and the delivery valves above, the water cylinders, which, with the large valve areas and free and direct water passages, tend to promote the utmost efficiency in the working of the pump. The valves are disks made of the best vulcanized rubber, working on gun-metal composition seats. The water cylinders are lined with gun-metal composition. The water pistons are packed with hydraulic cup leather packing. The air chambers are of ample capacity, and the delivery nozzle is a casting made curved instead of the usual T. piece.

As we have above stated, the general appearance of the pump is one of unusual strength, compactness and solidity, and in service at Cañon City it has proved a very durable and satisfactory piece of machinery. The Cañon City water works ranks as one of the best power water works in the country.

This design of pump is especially serviceable as a fire pump for mills, etc., where water power is used.

American Inventors.

If we may judge from the present activity of the business of the United States Patent Office, the race of American inventors is in no danger of dying out; but on the contrary, in spite of threatened restrictive legislation, that might be supposed to exert an unfavorable influence, shows a degree of fecundity that is astonishing. From the official statement of the Patent Office, it appears that the business of the office is constantly on the increase.

During the first five months of the present year, there were filed at the Patent Office 15,244 applications for patents, being 2,307 more than for the same period of 1881, and 3,039 more than for the corresponding months of 1880. The receipts of the office for the same period were $428,805.65, being an increase of $64,623.55 over 1881, and of $90,660.85 over 1880.

Many of the patents that are annually issued are doubtless worth very little, either to the world or to the inventor, but a fair proportion of them are really useful and valuable, and a few of exceptional value. The activity of our inventors is a healthful sign of prosperity in our industries.

The Manufacturer and Builder.

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This journal has the largest circulation of any mechanical monthly published in the United States. Its value as an advertising medium is therefore apparent.

Vol. XIV., No. 10. Fourteenth Year.

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New York News Company, New York.
New England News Company, Boston, Mass.
Central News Company, Philadelphia, Pa.
Western News Company, Chicago, Ill.
St. Louis Book and News Co., St. Louis, Mo.
Cincinnati News Co., Cincinnati, Ohio.
Detroit News Co., Detroit, Mich.
Pittsburgh Book and News Co., Pittsburgh, Pa.
Baltimore News Co., Baltimore, Md.
Rhode Island News Co., Providence, R. I.
San Francisco, News Co., San Francisco, Cal.
Brooklyn News Co., Brooklyn, L. I.
Newark News Co., Newark, N. J.
Northern News Co., Troy, N. Y.
Albany News Co., Albany, N. Y.
Toronto News Co., Toronto, Ontario, Canada.
Toronto News Co., Clifton, Ontario, Canada.

The Legal Inspection of Elevators.

One of our most influential dailies has lately been seriously exercised on the subject of elevators. The journal in question publishes a formidable list of accidents to elevators involving the loss of many lives, all of which have occurred within the last three or four years. The list in question merely includes the more notable accidents of this kind that have occurred within the period named, leaving the host of disasters of lesser importance out of consideration, probably for want of space. It publishes enough, however, to make its point very clear—namely, that the erection of these appointments to business houses, hotels and public buildings, which have now come to be looked upon as necessary, should be placed under some sort of supervision. Boilers in cities are carefully inspected by municipal authorities appointed for the purpose, with the very proper object of insuring the public safety; building commissioners are likewise invested with authority to supervise the plans for the construction of buildings, and to enforce the laws relating to the erection of fire escapes; and in numerous other directions the municipal authority is exercised to protect the lives and property of citizens from dangers that menace them. The same reasons that call for the exercise of such paternal authority in the cases above named, may be urged with equal force in the case of elevators. They have of late years multiplied enormously, until to-day scarcely any public building, hotel or business house of any pretensions is without one or more of them. The constantly increasing value of land in the business quarters of all our large cities, necessitating the erection of very high buildings, and consequently the employment of elevators to make their upper stories accessible, is daily multiplying the number of these indispensable conveniences, so that if there are reasons now for some sort of supervision in their erection, these reasons will become more imperative as time passes.

That the necessity for a rigorous inspection of this class of apparatus does exist, and has existed for years, no intelligent person can doubt who will recall the number of accidents attended with loss of life that has occurred within his own limited sphere of knowledge. Scarce a day passes without furnishing the newspapers with an item of this kind. In short, the elevator has taken its place with the railway and the steamboat in furnishing its daily quota of material for the accident column of our newspapers.

It would be grossly unjust to many reputable manufacturers of this class of apparatus to denounce them as the responsible agents for the numerous accidents that take place with elevators. The principal cause of the erection of poor and dangerous appliances of this kind, is doubtless to be found in the fact that the growing importance and extent of the business have attracted many into this branch of manufacture, and the fierce rivalry and competition between them, resulting from this state of things, combined with the public ignorance and indifference upon the subject, have made the use of cheap materials and flimsy construction necessary for many of them in the struggle for existence. The purchaser of an elevator, in ninety-nine cases out of a hundred, is incompetent to judge of the respective merits of the various forms of these appliances which are brought to his notice. To him, an elevator is an elevator, and the consideration of price is apt to weigh heavily in determining his choice. Where such a state of affairs exists, it is not difficult to account for the prominent part which elevators play in the accident columns of our daily journals.

The enactment of laws placing the construction and periodical inspection of these appliances under the control of competent officials chosen for the purpose, as urged by our contemporary, appears to us to be imperatively demanded for the public safety. No legitimate private interests would suffer by such a course, for no class of elevators need be excluded from the market, provided the appliances successfully meet certain general conditions concerning which there could be no dispute. The casualty list of our contemporary shows how fallacious it is to suppose that the choice of one system in preference to another will compensate for poor materials, faulty construction and careless management, for the list in question impartially embraces all of them. While the enactment of laws such as we have indicated, might not entirely do away with accidents of this kind, it may fairly be expected to greatly diminish their number, for the frequent inspection of such apparatus which such laws would necessarily provide for, would suffice of itself to prevent the majority of accidents, by revealing defects, detecting the weakening of parts by wear and tear, and careless or ignorant management.

Where the question is one that so directly involves the protection of human life as this one, we believe that no one will seriously dispute the propriety of the course we here advocate, and we are convinced that no one who will take the trouble to ascertain how fearfully common accidents from the breaking of elevators have become, will feel disposed to seriously dispute its necessity. We are more than gratified to observe so powerful a molder of public opinion as the *Herald* advocating this reform.

The Cable System of Street Railways.

In recent editorial remarks on the "Street Railway Problem," we took occasion to refer to the partial failure of the use of steam as a substitute for animal power. We referred briefly to the cable system and its apparent success, and desire here to supplement our previous remarks by additional facts and observations, which, we are pleased to state, speak very favorably indeed of this novel method of street-car propulsion.

The cable system was first introduced in practical operation in San Francisco in 1873, by Mr. A. L. Hallidie and his associates, on what is now known as the Clay Street Hill Railroad Co., the means employed being substantially the invention of the gentleman named. The difficulties of the steep grade on the line of this road were so great that ordinary horse cars were out of the question, and some substitute had to be found to make the route feasible. Mr. Hallidie's invention solved the problem successfully, and paved the way for the introduction of numerous other roads of a similar kind in that city, all of which have proved highly satisfactory in practice.

The essential features of the cable system, which is gradually making its way into other cities, are briefly described in the following: Between the tracks, which are of ordinary construction, is laid a tube, formed of sections laid end to end, and bolted together at the ends, so as to form a continuous passage. The tube is elliptical or circular in cross section, and from 12 to 20 inches in largest diameter. At the upper portion of the tube is a slot about ⅝ to ¾ of an inch in width, forming a continuous opening on the surface between the tracks the whole length of the line. The object of the tube is to carry a steel wire rope, which moves inside of it at the rate of about six miles per hour, being driven by a powerful stationary engine placed at the end of the line. The rope is carried on guide pulleys stationed at intervals of a few feet apart on suitable supports within the tube.

The cars are of the ordinary pattern, but are provided with a gripping device, which is controlled by the driver, and which connects the car on the track with the traveling wire rope, the shank of the grip passing up through the slot above described. By throwing the grip on the cable, the car is pulled along at the same speed the rope is traveling; and by throwing it off it is brought to rest. At each terminus of the cable road the wire rope passes from one tube to another, around a large horizontal sheave; and the transfer of the car from one track to another, the turning of curves, and the crossing of one line by another, interpose no serious mechanical difficulties.

As above remarked, a number of these roads have been in operation in San Francisco for several years with notable success. During the past year some five miles of cable railway have been laid down and operated in Chicago; and in response to inquiries made by the editor of this journal, the superintendent states that thus far the road has met every anticipation, and that before the close of the present year nine addi

tional miles will be placed in operation. He states that they have met with no difficulty from the accumulation of dirt in the tube (the provisions for removing the same being adequate), nor from snow and ice. They are able to make better time than with horses, and the operating expenses are 60 per cent less than with animal power.

We may add to this the statement that an experimental line of this kind is being laid down in Philadelphia, and will be in operation during the present month; and if successful, as it has proved to be elsewhere, it will be followed by others like it.

From all that we have been able to learn concerning the cable system, it would appear to have solved the vexed question of supplanting animal power for street-car propulsion in a very satisfactory manner. We hope to present illustrations showing the operation of this system in an early issue.

Electric Lighting in New York.

The experiment of introducing the incandescent electric light, which Mr. Edison's company is about attempting on the large scale in a district of this city, will be watched with more than common interest. It will be by far the largest trial of electricity as a competitor of gas for domestic lighting that has yet been tried, and on the success or failure of the experiment the fate of the electric light, for the immediate future at least, is intimately bound up.

Mr. Edison has earned a world-wide renown, and justly, as a most ingenious and daring inventor; he has command of ample resources, and enjoys to an eminent degree the confidence of the community. These are important and powerful aids in his present ambitious venture, which we sincerely trust may justify the confident expectations of himself and his associates.

There are many conditions, however, aside from that of cheapness, that the incandescent light must fulfill to meet the requirements of domestic lighting. Of these the most important perhaps is that of its reliability. It must demonstrate itself to be as reliable as gas, to take its place. There must be no failure of the lights from derangement of electrical connections, or other accidental causes, for a few such failures would be fatal to its popularity. It must be as manageable as gas, and the fixtures by which it is controlled must be free from complications and readily manageable. If these requirements are satisfactorily met, we are satisfied that the question of cost—within certain limits, of course—will be a secondary consideration. The incandescent light possesses so many advantages over gas light, that people will readily pay more for it than for gas light. It (the electric light) gives a clear and steady illumination, it gives out no noxious gases, and does not impoverish the air of a room as gas light does, and it evolves much less heat than gas. For these reasons its superiority as a means of illumination is obvious.

Mr. Edison and his associates propose to furnish their light at a very moderate cost, and it is to be presumed that, being engaged in an extensive business operation, they know what they can afford to do to yield themselves a fair profit on their investment. The whole question of the availability of electricity as a means of domestic lighting promises, therefore, to be determined in the immediate future.

While we do not contemplate the failure of this interesting experiment, we hold the opinion that the system of domestic electric lighting that will ultimately prove most satisfactory from an economic standpoint, and that will find the most general adoption, will not be based upon the plan of distribution from one great central source of power, as is the case in the system here under consideration; but, on the contrary, will involve the employment of portable secondary batteries, which will be charged with a sufficient supply of electrical energy at the central station to supply a number of lights for a certain period—say a month. Each consumer in a district (whose house is furnished with proper fixtures) would then be visited by the company's agent at stated intervals, who would remove the exhausted battery and leave a freshly charged one in its place. Before this plan can be introduced, however, it will require material improvements to be made in the construction of batteries of this class; but so much has been already accomplished that the prospects of further and radical advances in the direction indicated are very hopeful.

Whether he shall be successful or not, however, Mr. Edison's magnificent daring and energy must command the highest admiration. The public is warmly interested in his success, and it is not extravagant to declare that should such prove to be the outcome of his enterprise, as we trust it may, he will add to his well-earned honors as a distinguished inventor the distinction of being also a public benefactor, in having paved the way for what would be justly entitled to be called a real advance in civilization.

How to Do It.

We publish elsewhere a communication from a mechanic, who subscribes himself as "one of the many who desires to improve his condition in life," and who takes issue with us upon the statements and advice we offered in our September number in the article entitled "How may I Possess a Home?" He goes further than criticism, for he would have it appear that the article in question affords just ground of offense on the part of those for whom it was intended by the writer as a helpful and encouraging stimulant to industry and thrift. It is, we believe, the first time that we have ever been charged with giving willful offense to the class whose interests we have ever esteemed it to be our duty and privilege to forward and defend; hence we make special note of the fact. But, now, let us take up the points to which our correspondent takes exception.

In the first place, it may be as well to state that our article was not intended to apply exclusively to the latitude and longitude of New York; but for all that, we are well satisfied that every statement made in it will apply substantially as well to this locality as to others. Our correspondent's first objection, that the entire earnings of a mechanic for ten years would not suffice to buy a double tenement house in which many of them are compelled to live, sounds just a trifle absurd, and the absurdity of it seems to have struck him also, for in his next sentence he remarks that "it is true that if they had the money, they would not buy a house of that kind for their families," etc. What we speak of is a modest private dwelling, of which there are hundreds to be found in every city and town, or their suburbs. To this, New York and vicinity is no exception. There are dozens of towns and villages within half an hour of this city where a mechanic may take his choice from any number of dwellings such as we speak of, costing from $1,250 to $2,000, and pay for it almost upon his own terms. As to difficulty of access to the city, this will not be greater than residents of the upper part of New York labor under; the time consumed in journeying to and fro will not be materially greater, and the cost but little more than that of car fares. In some cities, notably in Philadelphia, the number of small but comfortable dwelling houses is legion.

Now, as to the ability of the average mechanic to become possessed of such a home. Our correspondent takes $900 as the average yearly earnings of the average skilled workman, and by a process of appropriating so much for rent, so much for this, that and 'tother, asks us how he can hope to accomplish the task of winning a home.

Now, at the risk of again giving offense, we will nevertheless express the opinion that (barring misfortunes, such as sickness and the like), there is something radically wrong somewhere, about the man or his household, if, earning this amount, he cannot succeed in laying aside out of it a snug little sum every year to provide against a rainy day, or, as we suggest, to secure a home of his own. We know whereof we speak when we make the assertion, that there are to-day in Philadelphia more than, ten thousand mechanics living in homes of their own, *bought and paid for* out of wages no higher, and in many cases less, than the figures our correspondent names. Philadelphia, we admit, by reason of the great development of the "building association" system, and its abundance of small houses, offers more favorable opportunities in this direction than New York; but similar opportunities are to be found in the latter city and elsewhere, and whatever difference may exist in the cost of living in different localities, is invariably compensated for in the rate of wages. It cannot surely be said that Philadelphia mechanics are more thrifty and economical than those of other cities, nor have they any notable advantages over their brethren in other localities in respect to better wages and lower cost of the necessaries of life, for, as above remarked, these elements are invariably so related that the advantages of one kind are offset by corresponding disadvantages.

There is but one way open to the wage worker to better his condition in life, and that is to make the resolution to keep the expenses of his household within his income, so that every week or every month will find something, however little, *saved;* and having made this resolution, let him adhere to it inflexibly. To do this, means to exercise the severest self-denial, to practice the most rigorous economy, and to suffer many mortifications, but the reward will be correspondingly great.

Yet another reflection. It is no exaggeration to say that ninety per cent of our rich men are, as the phrase goes, "self-made men"—men who were reared amid humble surroundings, with few advantages of education to aid them in the struggle against poverty, and with no powerful friends to lend them a helping hand. Many of them were workingmen (in the sense that this term is commonly used) far into the years of their manhood. These are the men who seem to get along in the world somehow, even under the most adverse circumstances. How they manage to do it, is always the wondering query of their less successful fellows. Take our word for it, there is neither mystery nor luck about their success.

Plain Facts about Boiler Explosions.

In a recent article emanating from the Hartford Steam Boiler Inspection and Insurance Company, we notice some very sensible facts respecting causes that conduce to boiler explosions, and which we believe will warrant us in commenting on.

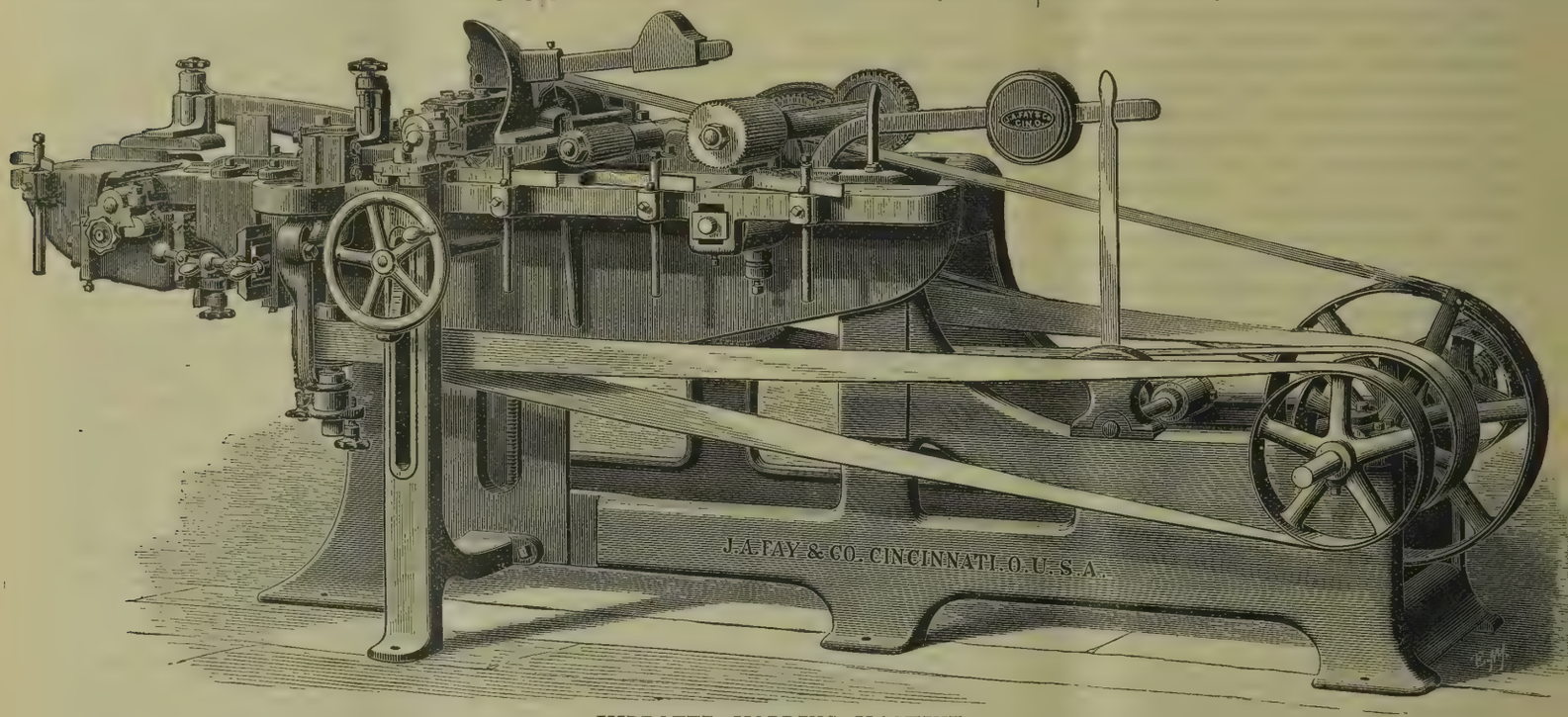
The writer remarks that the tendency to employ cheap and irresponsible men as engineers, contributes largely to the occurrence of accidents with steam boilers. This is a fact that cannot be too strongly placed before users of steam. Such economy is of the "penny wise and pound foolish" order, as many have found to their cost when too late. Intelligent service at good wages is cheaper in the end than ignorant service as a gift.

Another active factor mentioned, is the dangerous practice that prevails with manufacturers at times when business is pressing and orders are crowding them, of working their boilers up to their full capacity, and more. The evils of this practice are seldom estimated at their proper magnitude; and to the serious straining and weakening of boilers from this cause many disastrous explosions may be traced, directly or indirectly. The extensive experience of the Hartford company confirms these opinions in the most unqualified manner, as the following declaration will testify: "Experience teaches us that nine-tenths of the boiler explosions in the country are attributable to carelessness on the part of engineers, or to the cupidity and avarice of the owners, who, to save the expense of additional boiler power, will order their boilers to be run at excessive and dangerous pressures."

Improved Molding Machine.

The accompanying engraving represents the improved No. 4½ heavy, four-side molding machine, manufactured by J. A. Fay & Co., of Cincinnati, O., a standard machine of its class, which has been crowned with the highest honors at the World's fairs of Philadelphia, Paris and Melbourne.

The following is a detailed description of its construction and capabilities: This is a specially heavy and strong machine, and made to work 8, 10 or 12 inches wide, as may be desired. The frame is long, in order to give good length of belts and secure a large base upon the floor. The feed works are of the very strongest possible kind, and consist of three feed rollers, two above and one in the platen, all connected together and driven by a train of powerful expansion gearing, which will allow the bed to drop to take in 16 inches. The lower feed roll (which is in the bed) is of large diameter, and runs in adjustable bearings. The upper rolls are mounted in swinging yokes, and so arranged as to always raise parallel with the stuff being worked, and can be instantly raised so as to withdraw it from the knives if desired. The roll nearest the cutter head is of smaller diameter, and placed as close to the pressure bar as possible.



IMPROVED MOLDING MACHINE.

The cutter heads are four in number, and slotted upon their faces. The main or upper head is mounted upon a very heavy arbor which runs in self-oiling boxes and has a substantial detachable outside bearing, both for an outside support and for the convenience of substituting other heads, also an end adjustment across the platen. The under heads and both side heads are mounted on the bed or platen, and rise and fall with it. The former have an end adjustment by means of the hand-wheel. The latter have an angular and vertical adjustment independent of the bed, and can be adjusted laterally out or in from the working side of the machine. The table has moveable mouth pieces let in flush with the face, which can be adjusted more or less to close the gap of the lower head.

An upright column attached to the outside of the machine, extending up from the floor, receives the moveable detachable bearing, and affords a very solid outside support for the mandrel, essential for nice and accurate work. The bed or platen is raised or lowered to any desired hight by means of the hand-wheel in front, and instantly secured in position by the checking lever. This is a valuable improvement, as all danger to the operator from contact with the cutters in raising the bed, as in the old method with the elevating screw placed above, is entirely avoided. The feed is instantly stopped or started by means of a binding lever without jar or shock. The pressure bar and bonnet are combined, and can be swung instantly out of the way to secure ready access to the cutters. The machine is equipped with hold-downs, wrenches, pressure, feed, etc. The counter-shaft has 10×6-inch tight and loose pulleys, and should make 1,000 revolutions per minute.

The Mallet System of Furnace Combustion.

Considerable interest is at present being taken in certain novel plans for improving combustion in furnaces, with special reference to the more perfect combustion of fuel and the more economical generation of steam in stationary and locomotive boilers, which plans have originated with Mr. E. J. Mallet, Jr., of this city. The system devised by Mr. Mallet, though it possesses some features which have already been introduced with more or less success in practice, combines in itself a number of novel plans which have hitherto been introduced independently of each other; and the inventor has not only improved upon and combined them intelligently, but has introduced a number of new and ingenious features of his own. Taken as a whole, therefore, the Mallet system may be considered as a radical departure from the conventional methods of burning coal, and involves radical changes in the steam generator to operate it.

Without the assistance of cuts to illustrate the subject, we shall not attempt to enter into minute details, but shall confine ourselves to giving a general statement of its important and novel features.

Mr. Mallet terms his plan of burning fuel a system of "controlled combustion," and bases this definition upon his devices for effecting the admission to the fuel and fuel gases, of known and controllable volumes of air; the division of the air supply required for combustion into two volumes, one to burn the solid and the other the volatile constituents of the fuel; and for varying the relation of these two volumes of air, so that while the sum total of air entering the furnace may remain the same, the quantity coming into contact with the solid fuel, and with the gases evolved therefrom may be varied according to requirement. To effect these objects, a decided variation from the common method of setting boilers is introduced—namely, the separation of the furnace into two compartments, the fire-box and the combustion chamber, such separation being effected by a brick dividing wall, to take the place of the ordinary bridge wall, and having apertures through which the fuel gases may pass and enter the combustion chamber in a controllable manner. An exhaust fan replaces the chimney, and produces the necessary draught by drawing the gases from the furnace instead of forcing the air into the ash-pit, as is the usual plan where artificial draught is employed. The air necessary for the combustion of the fuel gases enters the combustion chamber through the grate bars, which are tubular, having one end in communication with the external air and the other end opening into the combustion chamber just below the apertures in the division wall through which the fuel gases are admitted.

To effect the complete combustion of the gases that are given off from the fuel in the fire-box (which in the Mallet system simulates a gas retort), provision is made to throttle the air that enters the ash-pit and admit the necessary volume to the combustion chamber through the hollow grate bars, by the exhausting action of the fan. With a fresh charge of coal the volume of gases evolved is very great, and the quantity of air required in the combustion chamber is correspondingly large. As the volatile elements are gradually given off, eliminated and burned, the admission of air to the combustion chamber is cut off, and a correspondingly larger amount is admitted to the ash-pit and effects the burning of the solid fuel. These operations of dividing the air supply, while maintaining the equality of the total quantity admitted in a given time, are effected by means of a simple lever controlled by the operator. The ash-pit door has a sliding register which admits of any desired opening, or can be closed entirely, and the open ends of the grate bars are similarly provided. The attendant, therefore, by moving the handle of the lever, controls the air distribution to the fire-box, or to the combustion chamber, as may be required by the condition of the fuel.

To avoid the burning out of the fan by the action of the heated combustion products exhausted through it, the inventor, instead of drawing it at once through the fan, passes it first into a chamber containing a coil of pipe, through which the feed-water is circulated before entering the boiler. The heated combustion products are met in this chamber with a fine spray of water, which effectively deprives the gases of heat and communicates it to the feed-water coil. The amount of spray water used for this purpose is

said to be very small. The combustion products cooled off below 200° Fah., according to our account, are then delivered through the fan into the atmosphere.

The above description relates to the application of the Mallet system to stationary boilers, and it is affirmed that it has been found to operate in practice in the most satisfactory manner, showing a large economy in fuel. The system is also adapted to locomotive boilers, and a consolidated locomotive is reported to be at present in course of being supplied with the necessary appliances to test the new system.

We shall follow the developments of this promising system of burning fuel, with interest, and should it prove to be all that is claimed for it, it will effect a decided revolution, effecting not only a very decided economy in steam generation, but effectively suppressing the smoke nuisance. Before any decided opinions respecting its merits can be safely formed, however, it must be submitted to the crucial test of practice. All that we can say of it at present, is that it appears to embody a number of correct scientific principles, and promises very well.

Hege's Improved Circular-Saw Mill.

The accompanying engravings represent some of the more important details of an improved circular-saw mill, designed by Mr. C. A. Hege, and manufactured at the Salem Iron Works, Salem, N. C. When it is remembered that the circular-saw mill is rapidly displacing the other styles of mills on account of its general superiority, both as regards quality and quantity of work, a claim to substantial improvements in its details, as pronounced as those made by this inventor, is worthy of careful consideration. We shall endeavor in the following to describe the salient features of Mr. Hege's improvements.

Fig. 1 is a perspective view of Hege's No. 5 improved circular-saw mill, provided with a universal log beam, rectilinear simultaneous set works, double eccentric friction feed, and improved crank attachment to throw back the log beam.

From an inspection of the engraving, it will be noticed that instead of having two or more head blocks, with uprights acting independently or simultaneously, as with screw head blocks and some lever-sets, a sufficient number of head blocks are provided, and placed across the carriage, at intervals of four or five feet, throughout its entire length. Upon these is a long bar, or slide, of wood, to which are rigidly fastened the cast-iron uprights or knees for the log to rest against. Two or more of the head blocks, at suitable distances from each other, are provided with racks extending their entire length on one side, as shown in Fig. 1, being, in the cut, the second block from each end of the carriage. In the under side of the wooden slide, or log beam (Fig. 2), is a groove running its entire length. In this groove are arranged racks on each side, and so placed that when the log beam is about the middle of the carriage, the center of each set of racks will be directly over the racks on the head blocks before mentioned. Both of the racks on one side of the groove are connected by a strong bar of wrought iron, so that as one rack is pulled endwise the other rack on the same side must move exactly the same. The two racks on the other side of the groove are connected together in the same way. A pinion for each set of racks (shown in cut) is of proper size to gear into the racks on both sides of the groove at the same time, and extends far enough below to also gear firmly into the rack on the side of the head block underneath.

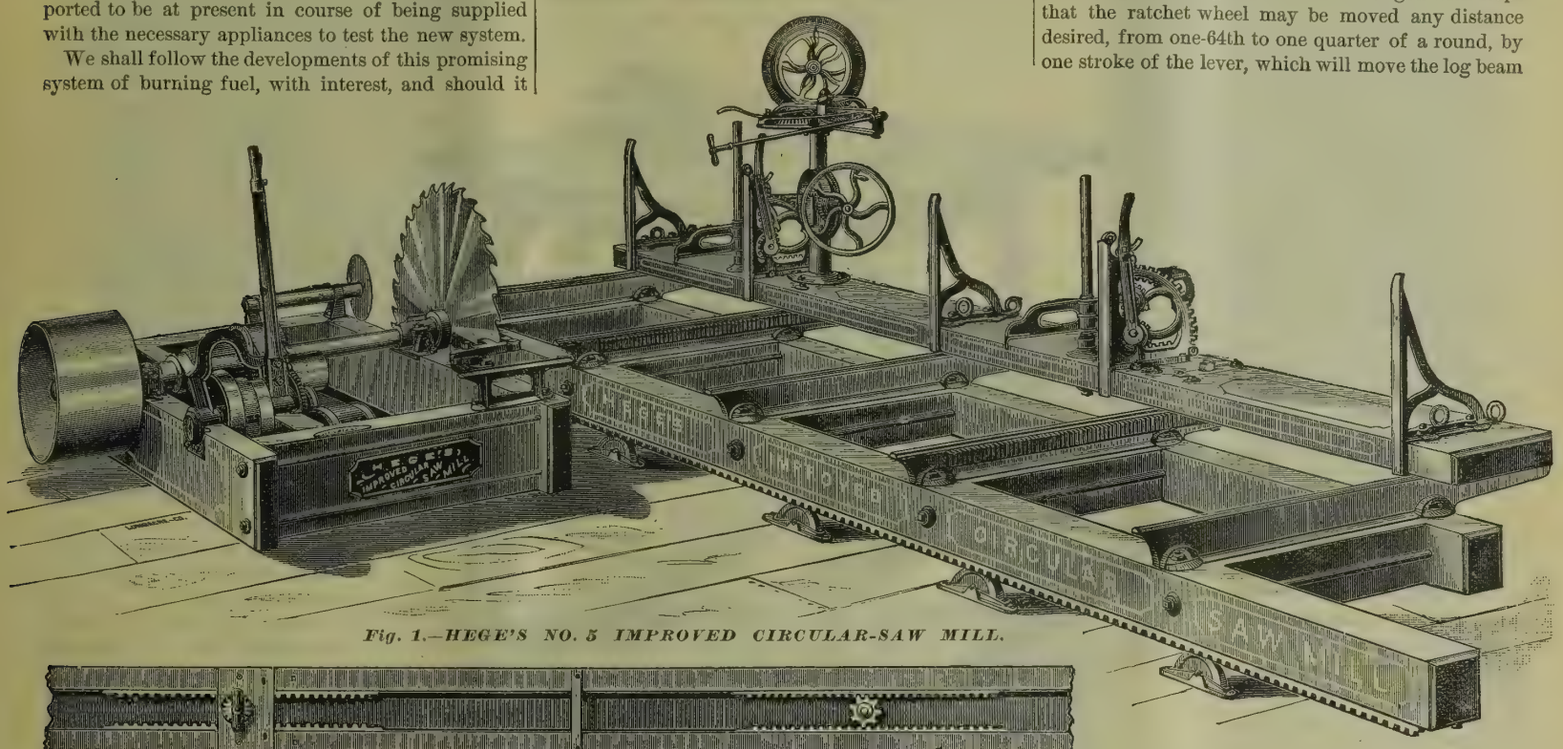


Fig. 1.—HEGE'S NO. 5 IMPROVED CIRCULAR-SAW MILL.

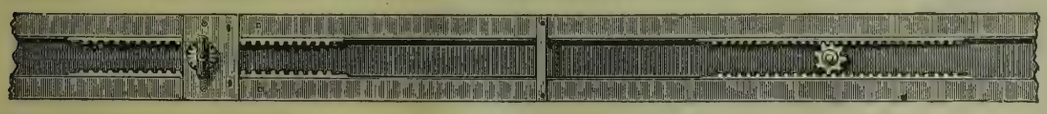


Fig. 2.—Under Side of Log Beam.

In one of these pinions is secured one end of a shaft, which extends upward through the log beam, and through the support for the dial plate, to the top of the dial plate (Fig. 3), where the end is secured in the ratchet wheel. This ratchet wheel may be turned in either direction by the lever and pawl, thus giving motion to the pinion below. This pinion in turn, by means of the racks in the groove of the log beam, moves the other pinion in the same direction, and exactly the same distance that it is moved; and both pinions being, as before stated, geared into the racks on the side of the head blocks across the carriage, any motion given to them must cause the log beam to move across the carriage, both ends moving at the same instant and precisely the same distance, as it is impossible to spring a strong bar of iron by pulling it lengthwise. There are eight cogs on each pinion, and on the racks across the carriage there is one cog to every inch. By turning the ratchet wheel one-eighth of a round, the log beam will be moved just one inch. The dial plate (Fig. 3) is so graduated and arranged with stops that the ratchet wheel may be moved any distance desired, from one-64th to one quarter of a round, by one stroke of the lever, which will move the log beam from ⅛ to 2 inches. When the stops are set for any particular thickness of lumber, and the lever is moved the full distance between the stops, it will always move the log beam the same distance. The lever by which the ratchet wheel is turned is easily moved by the sawyer, even when there is a heavy log on the carriage. With this log beam in use, the log, while being sawed, is braced and supported every few feet, and, at the same time, is held firmly by the self-adjusting dogs, so that there is no possible chance for it to spring. With this setting device the sawyer does all the setting of the log to be sawed easily, quickly and accurately, without leaving his place at the saw.

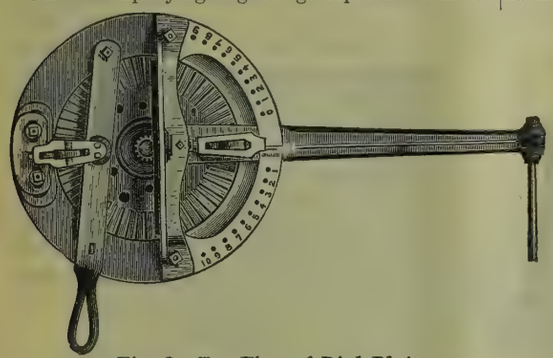


Fig. 3.—Top View of Dial Plate.

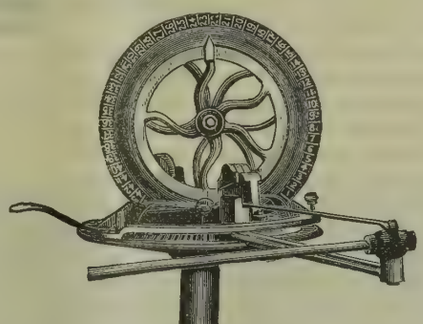


Fig. 4.—Front View of Circular Indicator.

Fig. 4 gives a front view of the circular indicator, showing the pointer wheel on top of the dial plate, and other details of its mechanism. In Fig. 3 (a top view of the dial plate) the holes are shown numbered both ways from the center, each number representing an eighth of an inch. In the same figure will be seen the beveled pinion, which actuates the pointer wheel in the circular indicator.

For further details respecting these improvements, we refer to the manufacturer, whose address is given above.

Improved Wood-Working Machinery.

The adjoined cuts represent the appearance and construction of certain special wood-working machines manufactured by the Battle Creek Machinery Co., of Battle Creek, Mich., and which have found a very general introduction into wood-working establishments by reason of their excellent adaptation to their intended uses.

Fig. 1 represents the Preston dimension Saw, manufactured by these makers, which may be described as a shop saw possessing a number of features of simplicity and convenience which add to its value. It has an all-iron frame and top; it combines all the necessary facilities required in a shop saw for cutting and slitting right and left angles, and bevels at any angle. The gauges are light, simple and easily handled. The saw arbor is of steel, 25 inches in length. It has long bearings, is hung in a swinging frame, hinged on the counter-shaft in such a manner as to avoid all wear, and to secure a uniform length of belt. The swinging frame is raised and lowered by a worm working in a worm pinion on a shaft carrying two links, connected at each side of the frame, thereby securing accurate and positive movement of the saw up and down, and positive position. The top is hinged near the rear end, and may be raised to a perpendicular and standing position when necessary, but need not be raised for general purposes, as there is a loose throat piece in the top that may readily be removed for the admission of different size saws, dados, or other tools. The saw arbor is fitted at the end opposite the saw, to receive a boring bit, and the frame is calculated to receive a table for boring. The saw arbor has all the vertical adjustment necessary for a boring table, which may either be of wood or iron. Where the latter is desired, they are furnished by the makers with gibbed slides, all ready to attach to the saw frames.

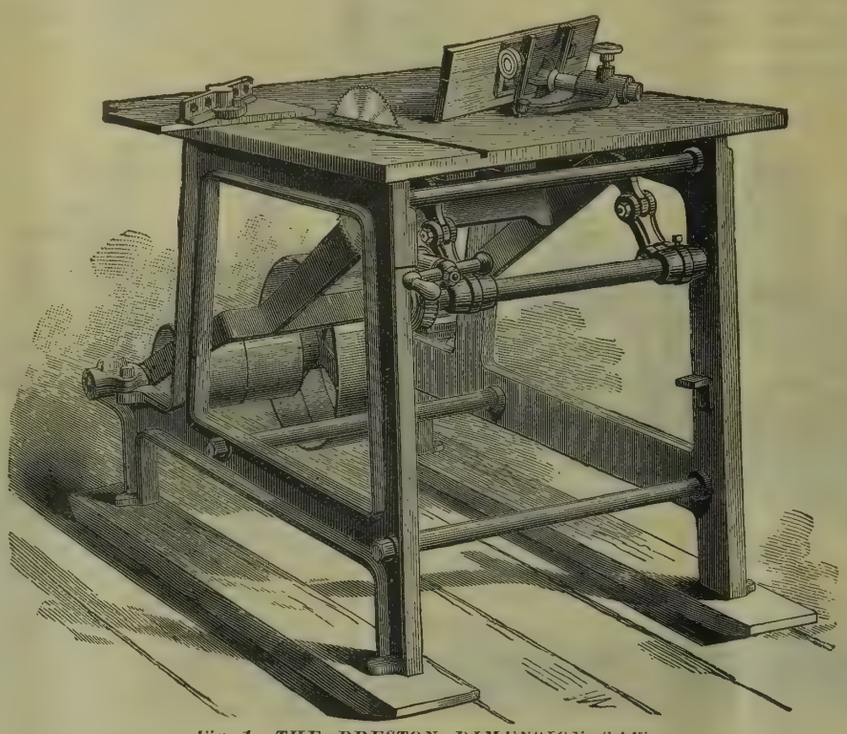


Fig. 1.—THE PRESTON DIMENSION SAW.

This machine is capable of considerable variety of work. It is strong, compact and of very reasonable cost.

Fig. 2. represents a special machine of the same makers, which has been previously described in our columns. It is the Standard Dovetailer, which has been long and successfully used in connection with Boult's molder and paneler, but which is here placed on a substantial frame designed specially for its use. It is an independent dovetailer, and for this special work the machine is much simplified and cheaper in cost in comparison with the combination machine, since many of the fixtures necessary with the latter are dispensed with.

The frame is one solid casting, the top is of iron, planed smooth and true, 30 inches square, affording sufficient table room for a shaper and edge molder for small shops. The spindle is erected in the center of the trunk, upon solid parts of the same. The upper journal runs in a babbitted box; the lower journal runs through a brass sleeve and rests upon a tempered steel pivot, and has an oil supply. It has a screw hand-wheel at the bottom for adjustment up or down. The cutter is held by a short steel chuck attached to the spindle by a taper fit, so that it will never get loose or out of line, and can readily be replaced when worn. The spindle will also receive the stem chuck for holding the solid cutters of the manufacturers, or flat knives for edge molding or shaping. It will cut both the front and side of a drawer at one time; and if narrow, two fronts and two sides at one time. It dovetails with equal facility on any thickness from $\frac{1}{4}$ to $1\frac{1}{2}$ inches, and up to 13 inches in width.

To those who have been familiar with the paneling machine of these manufacturers with which the dovetailing attachment was combined, it will be apparent from the foregoing description, that, for its special work, the independent machine is admirably well adapted, while its cost is materially reduced.

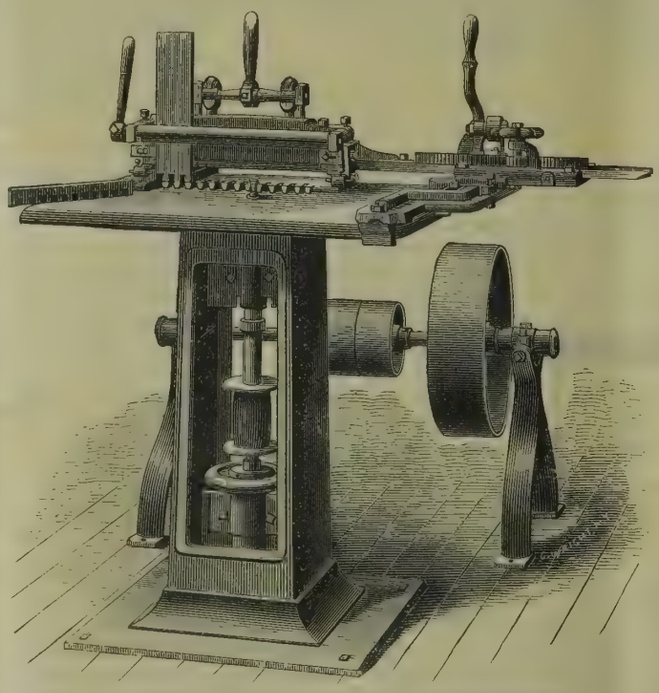


Fig. 2.—BOULT'S INDEPENDENT DOVETAILER.

The makers will supply any information that we may have omitted, and will send specimens of its work.

GLASS SPINNING AND GLASS FLOWER MANUFACTURE is a very extensive branch of the Austrian glass industry. It is now so developed that a petroleum flame gives some 1,550 yards of glass thread every minute, that is woven not only for glass cloth, etc., but also for watch chains, brushes, etc.

The Relative Merits of Electric Lighting and Gas Lighting.

The distinguished president of the British Association (Dr. Siemens), in his recent presidential address, made some interesting comparisons between gas and electricity for illumination, with special reference to the future field of these agents, which are of special value at the present time when the subject is attracting so much of public attention.

Dr. Siemens expressed the opinion that the electric light could never supersede gas as an economical means of illumination. Gas he called "the poor man's friend." "Gas," he explained, "is an institution of the greatest value to the artisan; it requires hardly any attention, is supplied upon regulated terms, and gives, with what should be a cheerful light, a genial warmth, which often saves the lighting of a fire."

Gas, therefore, has advantages which apparently can never be overcome by electricity. Even assuming the cost of the electric light to be practically the same as that of gas, the preference for one or the other will in each application be decided on the grounds of relative convenience; but gas, he seems to think, must always be more generally adapted to the wants of the public. Moreover, electric competition is leading to technical progress both in cheapening the cost of production and increasing the purity and illuminating power of gas; and improved burners, rivaling the electric light in brilliancy, greet our eyes as we pass along our principal thoroughfares.

As Dr. Siemens says, "it can no longer be a matter of reasonable doubt that the electric light will take its place as a public illuminant;" and he holds that even if it shall be found more costly than gas, it will be preferred for certain uses, such as lighting drawing-rooms and dining-rooms, theaters and concert-rooms, museums, churches, warehouses, show-rooms, printing establishments, factories, and also the cabins and engine-rooms of passenger steamers.

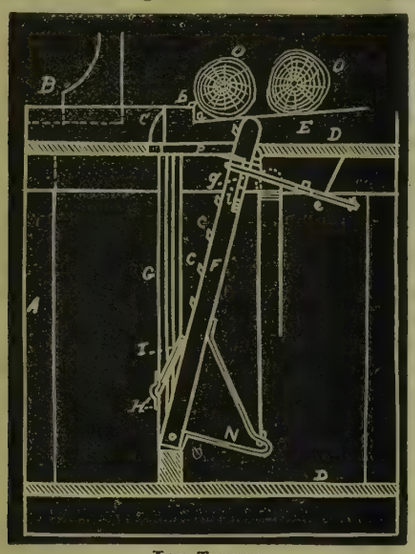
Whether electricity can be so sent from central stations over a large area to thousands of lamps that it shall be as unfailing as gas light, and as business necessities and domestic conveniences requires that it shall be, is yet to be determined.

NEW DISCOVERY OF NICKEL ORE.—At a recent scientific meeting in San Francisco, announcement was made of the discovery in southern Oregon of a large deposit of nickel ore, resembling that discovered in New Caledonia in 1864, the development of which by the French has so greatly extended the economical use of this metal. The New Caledonia minerals are known as garnierite and noumeite, both hydrated silicates of nickel and magnesia, occurring with chrome iron, steatite and other minerals found only in serpentine. There are, likewise, two of the Oregon minerals, one dark and the

other pale apple-green, like those of New Caledonia, and closely corresponding with them in hardness and specific gravity.

Recent Improvements in Wood-Working Machinery.

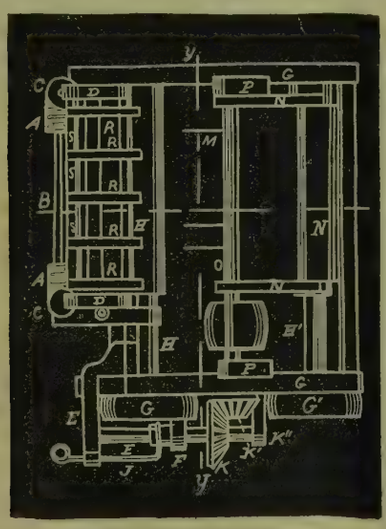
Frank McDonough, of Eau Claire, Wis., patents



Log-Turner.

the following improvement in log-turners, which will be understood from the claims, viz.: 1. The log-turner F, arm or crank I, rock-shaft H, and arm or lever J, in combination with the rod or bar L, for operating the arm or crank I and throwing the log-turner out of perpendicular. 2. The log-turner F, arm or crank I, rock-shaft H, and arm or lever J, in combination with the weighted rod or bar L and and weighted rod or lever K, for bringing the arm or crank I into position to bear against the log-turner and return it to its normal position. 3. The combination, with the carriage, log-ways and the log-turner or canter, pivoted at its lower end to swing out of perpendicular, and having a projection *g* at its upper portion, of a pivoted bar *e*, having a catch *f*, adapted to engage the projection on the log-turner or canter when the latter is swung back, and to hold the same out of perpendicular for a portion of the vertical movement, and to then automatically release the said log-turner or canter.

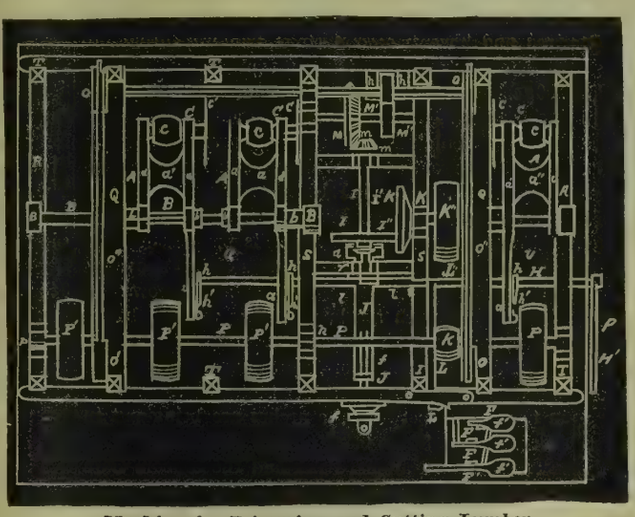
The same inventor patents a machine for trimming and cutting lumber, which will be understood from the following claims: 1. The independent



Edger Sawing Machine.

swinging frames A, each carrying a saw and having an arm or extension, in combination with the link or rod *d*, double crank D D', connecting the link E and crank-shaft F, for raising one or more of the saws independently of the others. 2. The independent swinging frames A, each carrying a saw and having an arm or extension, in combination with the link *d*, double crank D D', link or rod E, arm *f*, shaft F and foot treadle F', for bringing any one or more of the saws into position. 3. The independent swinging frames A, each carrying a saw and having an arm or extension, in combination with the link *d*, double crank D D', rod or link E, crank shaft F *f*, foot treadle F, hook *g*, and rod or bar G, for raising any one or more of the saws into position for use and locking it into position. 4. The independent frames A, each carrying a saw and having an arm or extension, in combination with the rock-shaft H, having arms *h*, links or bars *h'*, and lever or arm H', for simultaneously raising all the saws into position.

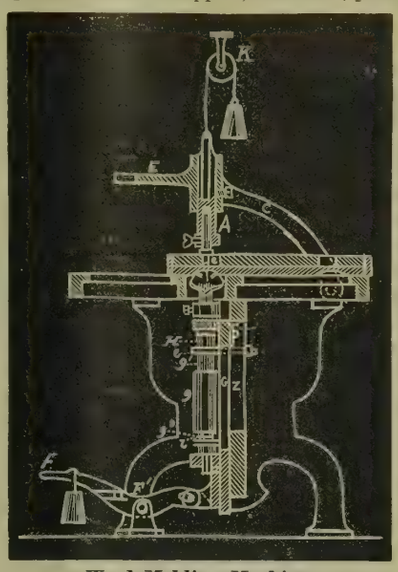
An edger sawing machine of the same inventor is thus described: 1. In an edger or sawing machine, the combination of a rotary shaft provided at its end with a screw-thread or worm, with a gauge roller journaled to rotate in a horizontal plane at the outer portion of the screw-thread or worm, and constituting a rolling bearing for the material, which is drawn up against the same by the said screw-thread or worm. 2. In an edger or sawing machine, the combination of the shaft B, journaled directly at the receiving or front end of the machine, and provided with a screw-thread or worm A, the gauge roller C, journaled to rotate in a horizontal plane adjacent to the outer portion of the said screw-thread or worm, and the feed rollers H, arranged in the rear of the said shaft and



Machine for Trimming and Cutting Lumber.

driven independently of the same, said screw-thread or worm shaft rotating at a greater speed than the feed rollers, whereby the material is drawn up against the rotary gauge, which affords a rolling bearing for the same. 3. In an edger or sawing machine, the shaft B journaled directly at the receiving or front end of the machine, and provided at each end with a screw-thread or worm A, in combination with the gauge rollers C, journaled to rotate in horizontal planes at the outer portions of the screw-threads or worms, and the feed rollers A, arranged in the rear of the said screw-threaded or worm shaft, and driven independently of the same, said shaft rotating at a greater speed than the feed rollers.

For a wood molding machine, Laurence Wenchel, of Baltimore, Md., makes the following claims: 1. The combination in a machine for ornamentally working wood, of a cutter arranged to operate beneath the table, with a guide-pin holder A, arranged to be raised and lowered independent of its carrying-frame, a counter-balance for said guide pin, and a slotted pattern carrying the work over the cutter. 2. The combination in a machine for ornamentally working wood, of a cutter arranged to operate beneath the table, with a guide-pin holder A, arranged to be raised and lowered to be freed from and inserted within a slotted pattern independent of its carrying-frame C, and a counter-balance for said pin holder. 3. In combination, the cutter, the fixed table, the slotted pattern carrying the work over the cutter, the guide pin, its holder or support, the cord J, pulley K,

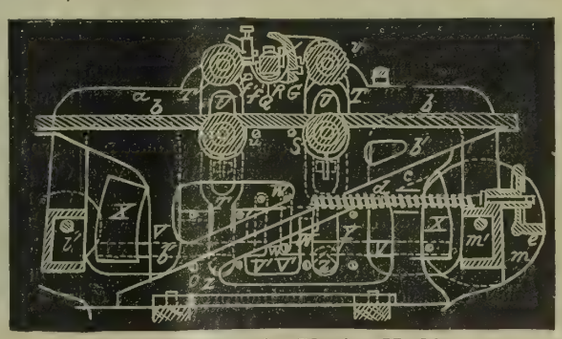


Wood-Molding Machine.

and weight J, the said cord being connected to the upper end of the guide-pin stem. 4. The combination, in a rosette-cutting machine, of a treadle suspended by and having an unyielding connection with the work-holding device, and connected with the cutter-carrying slide G, with the spring *g*, and means whereby it is made adjustable to regulate its force according to the power required to hold the work under the action of the cutter.

The following points are claimed as novel by Baxter D. Whitney, of Winchendon, Mass., for improvements in a bed and presser for planing machines: In a planing machine, the combination, with the cutting cylinder *f* and its journal boxes or bearings, provided with curved grooves R, partly surrounding the journals of the cylinder and concentric, or nearly so, therewith, of the presser bar G, having curved guides adapted to engage with and slide in the grooves R, whereby said bar is enabled to lift in a curved line substantially concentric with the cutting edges of the revolving knives.

An Improved Wood Screw.—Screws used in soft wood are usually driven in with a hammer, and given a turn or two with a screw-driver to bring them flush. A manufacturer has brought out a new screw which is adapted for driving, and which enters the wood



Bed and Presser for Planing Machines.

without tearing the grain, as the ordinary screw does. The gimlet point is dispensed with and a cone point substituted. The thread has a pitch that it drives in barb fashion, offering no resistance in entering, but firmly resisting all attempts to withdraw it except by turning it with a screw-driver.

Building Intelligence.

Architects, Builders and Contractors are invited to send us items of interest for this department. It is our object to notice only the more important operations in building, our space being too limited for the publication of minor matters, which, besides, possess only local import. We wish to publish only such intelligence as is of general interest.

New York City Building Items.

R. L. Darragh proposes to erect a five-story brick factory on the southeast corner of First avenue and and Seventy-fourth street.

James Gray & Co. propose to erect a five-story brick carriage factory on the northwest corner of Seventh avenue and Fifty-third street.

A bachelors' apartment house is to be built at the corner of Fifth avenue and Forty-second street. The builders are Jas. B. Smith, Prodgers & Co.

Cornelius Callahan proposes to erect a five-story flat house, 25 by 65 feet, with an extension 21 by 22 feet, at No. 226 East Twenty-seventh street.

A Methodist Episcopal church is to be erected at Eighty-sixth street and Park avenue, at a cost of $70,000, together with a parsonage to cost $10,000.

The New York Mercantile Exchange has purchased three lots on the corner of Harrison and Hudson streets, for $70,000, on which they are going to erect a building.

The Alcazar, corner of Forty-first street and Broadway, is to be altered, and among the improvements will be the introduction of proscenium boxes. G. E. Harding is the architect.

A new place of worship is to be erected for the congregation of the Emmanual Baptist Church, at Suffolk and Grand streets, at a cost of $30,000. It will be of brick and terra-cotta.

Koster & Bial are erecting a six-story brick building corner of Chatham and Worth streets, which will cost $40,000. It is to be 62 by 53 feet by 64 feet 3 inches. The architects are H. J. Schwarzman & Co.

Hugh Smith intends to build, at the southwest corner of Avenue B and Sixteenth street, a five and six story brick apartment house, about 95 feet 6 inches by 130 feet. It is to cost $100,000. The architect is S. D. Hatch.

Platt, Deutsch & Co. will soon commence the erection of a five-story brick cigar factory, 50 by 100 feet, on Sixty-third street, west of Avenue A, with two large brick tenements adjoining the same, at a cost of $70,000.

The work of rebuilding the interior of the Protestant Episcopal church of the Incarnation, at the northeast corner of Madison avenue and Thirty-fifth street, which was entirely destroyed by fire a few months ago, has been begun.

A six-story iron and brick store is to be erected at Nos. 600 and 602 Broadway and 134 and 136 Crosby street. It is to cost $150,000, and is owned by Elizabeth W. Aldrich. Architect, S. A. Warner; builders, J. H. Masterton and McGuire & Sloane.

Hugh Blesson is having plans drawn for the erection of two first-class apartment houses, seven stories high, 37 feet 6 inches by 90 by 100 feet, on the south side of Fifty-eighth street, 100 feet east of Ninth avenue. There will be two elevators and modern appliances.

Patrick Whalen proposes to commence at once the erection of four superior flat houses and two private dwellings, on the plot of ground recently purchased by him on the southwest corner of Seventh avenue and One Hundred and Twenty-eighth street, 100 by 125 feet, at a cost of $140,000.

Samuel H. Bailey intends to improve the plot of ground just purchased by him on the northwest corner of Seventh avenue and One Hundred and Twenty-seventh street, 100 by 125 feet, by the erection of four first-class brown stone flat houses on the avenue, and two superior private dwellings on the street, at a cost of $140,000.

William Jose has plans in hand for a seven-story brick malt house, 52 by 150 feet, to be erected on the south side of Fifty-seventh street, 150 feet west of Tenth avenue. It will be fitted with newly patented kilns, and will have a capacity of 200,000 bushels. Conrad Stein, the owner, expects to expend $70,000 on this structure.

For the Williamsburg City Fire Insurance Co., a building 25 feet 3 inches by 110 feet 4 inches, with an L 20 by 48 feet, is to be built at the corner of Broadway and Liberty street. It is to be eight stories high; the basement will of Quincy granite, the first floor of Westerly, and above the front will be of brick, brown stone and terra-cotta. The cost will probably be about $150,000. F. Charles Merry is the architect.

Terence Farley & Son will erect an eight-story brick and brown stone apartment house, 75 by 90 feet by 100 feet, on the plot of ground just purchased by them on the north side of Fifty-seventh street, 100 feet east of Ninth avenue. There will be accommodations for three families on a floor, and the feature of the building will be one magnificent entrance. It will be fitted with two elevators, and cost about $150,000.

Thom & Wilson are engaged on plans for two five-story flat houses to be erected on the south side of Ninety-second street, 225 feet west of Third avenue. One will be 30 feet front and the other 20 feet, with a uniform depth of 85 feet. The fronts will be of blue stone to the first floor, and from there up of brown stone. They will be trimmed in hard wood, cabinet style, throughout, and the cost will be about $50,000. The owner is Morris R. Williams.

L. B. Wheeler has drawn plans for the erection of a first-class apartment house on the plot of ground on the northwest corner of Eighth avenue and One Hundred and Twenty-second street, running through to St. Nicholas avenue, 28 feet 6 inches on the street, 100 feet 11 inches on Eighth avenue, and 118 feet 5 inches on St. Nicholas avenue. It will be five stories high, and contain all modern improvements, and as it has three fronts, there will be ample light and ventilation. The owner is Edward J. King.

Work upon the new Produce Exchange building, at Broadway and Beaver street, is progressing rapidly, and the structure already rises 60 feet above the sidewalk level. Two of the six stories are now completed. Workmen are busy putting up iron beams and columns; the terra-cotta ornamentation of the arches on the second floor is going forward rapidly, and the insignia of the various States of the Union, in terra-cotta, between the arches are being put in place, a dozen States being already represented.

The Lincoln National Bank and the Lincoln Safe Deposit Company are erecting a large building on Forty-second street, almost opposite the Grand Central Depot. The first story, of Belleville stone, is almost completed; the upper stories, which will be of pressed brick, will present a rather novel appearance, as they will contain no windows whatever. The bank and offices of the safe deposit company will be in the first story, while the upper part of the building will contain many small rooms for the storage of valuable paintings, heirlooms and furniture.

The Stewart building on Broadway, between Chambers and Reade streets, is to be changed into a structure suitable for office purposes. Edward E. Harris, the architect, has drawn the plans, and they have been filed in the Building Department by Mrs. Cornelia M. Stewart. The property now consists of three buildings, which are to be so altered as to have a joint roof 102 feet from the curb, and will be seven stories high. The roof will be partly flat and partly mansard. In the alterations contemplated, the front of the building will not be disturbed, but the rear part of the property, running between Reade and Chambers streets, is to be taken down and rebuilt. When completed, there will be an inner court of 26 by 130 feet, from the floor to the roof, for purposes of light and ventilation. The partitions between the various offices will be fire-proof. Thus another great office building is to be added to the many which have been constructed during the last six years in the lower part of New York.

Miscellaneous.

A large hotel is to be built at Bar Harbor, Me., by Boston capitalists, for the next season.

A court house is to be built at Washington C. H., in Fayette county, Ohio, to cost $100,000.

It is proposed to build a depot near the freight house on Railroad street, Willimantic, Conn.

A new hotel is to be built at Rye Beach, N. H., in place of the Farragut House, burned last winter.

A two-story brick court house is to be built for Atchison county, at Takis, Mo., at a cost of $90,000.

A town hall is to be built at Pittsfield, Me. It is to be 70 by 90 feet, of brick, and to cost about $20,000.

It is the purpose of the Chamber of Commerce of Minneapolis, Minn., to erect a building at a cost of $125,000.

A new school house is being built at Minneapolis, Minn. It is to cost $20,000. C. P. Randall, of Chicago, is the architect.

A new high-school house is being built at St. Paul, Minn., to cost about $80,000. C. P. Randall, of Chicago, is the architect.

The new Catholic church, with seatings for 1,200 people, is to be built on the corner of Winter and Primrose streets, Haverhill, Mass. The foundation is to be put in this autumn.

A chapel of granite, in the English Gothic style, is being built at Hartford, Conn., at the entrance of Cedar Hill Cemetery, to cost $30,000. It will be called the Northam Memorial Chapel.

A commercial building is to be erected at the corner of State and Church streets, Rochester, N. Y., for S. D. Walbridge. It will be six stories high, and cost $45,000. Warner & Brockett are the architects.

R. J. Dobbins has decided to build a new hotel on the lot adjoining the Howland House at Long Branch, N. J., and work is to commence at once. It will be of brick and iron, and will cost $300,000.

At San Francisco, Cal., the First Presbyterian Society has purchased a site for a new church, on the corner of Van Ness avenue and Sacramento street. It is expected that the church will cost some $20,000 or $25,000.

Charles S. Gray has purchased for $30,000 the property in South Sixth street, near the junction of Broadway and Fourth street, Brooklyn (E. D.), N. Y., for the erection of a theater, to cost $50,000. It will be called Gray's New Opera House.

Designs are being prepared for shops and a town, comprising 1,000 houses, churches, schools, a library, theater, etc., on a similar plan to Pullman City, for the United States Rolling Stock Co., near Chicago. Wilson Bros. & Co., of New York, are the architects.

William Jose is engaged on plans for one apartment house and three four-story brick tenements, to be erected on the corner of River and First streets, Hoboken, N. J. The corner house will be 22 by 51 feet; the one adjoining it on River street, 28 by 51 feet; while the two on First street will be 30 by 38 feet each. Myer & Steneck are the owners. The cost is to be $35,000.

The Illinois Central Railroad will at once begin the erection of a depot where the ruins of the former depot (burned in the great Chicago fire of October 9, 1871) still stand. It will cost over $500,000, and will be completed in 1883. It will be jointly occupied by the Illinois Central, the Michigan Central, the Baltimore & Ohio, and the New York, Chicago & St. Louis railroads.

C. W. Clinton is preparing sketches for several large and magnificent country seats at Islip, N. J. They are to be constructed of wood and brick, and the interiors will be finished in hard wood. Several wealthy New York gentlemen are the owners. Mr. Clinton is also completing four or five elegant residences at Saranac, N. Y. A very neat cottage at Great Neck, L. I., is in course of construction; and extensive alterations are being made on the Rawsley estate at White Plains, N. Y.

The Improved Westinghouse High-Speed Engine.

We present in the following some additional information respecting the highly ingenious and original form of high-speed engine which we described and illustrated in our issue for May of the current volume. These engines, though they have been before the public but for a brief period, have already come into extensive use for electric lighting, for direct connection to roll trains, for main lines of shafting in shops and factories, and in many situations where economy of space is of importance.

Fig. 1 shows the Westinghouse engine of latest pattern, placed upon a foundation and belted to a main line of shafting.

For the details of the peculiarities of design and general construction of this engine, we will refer to our previous article (*vide* this journal, page 100, current volume). We are interested here chiefly in presenting certain details not noticed in that article, and which are of special interest to mechanical engineers.

First is the arrangement of crank shaft bearings. These are made in the form of removable shells, lined with babbitt metal. These shells are tapering, and are fitted to a case. The bearings are babbitted upon a steel mandrel, ground so as to exactly fit the journals, so that the skin upon the metal is preserved, thus insuring better wear. To provide against heating of the journals, by reason of improper adjustment by an inexperienced person, a collar is provided. The end thrust of the shaft is taken by a Damascus bronze collar, while to insure perfect lubrication oil-ways are cut in the face of the journal.

To take up the oil that will flow past the journal, and for which drip pans were provided in the older forms of this engine, an ingenious device in the form of a centrifugal wiper has been introduced, which takes up the oil as it flows into the rear at the bottom by means of its revolving arms, carries it over the bridge at the top, and through a pipe back into the inside of the case, a portion thereof finding its way through a hole provided into the oil cup. No oil can escape through the cover, and the engines are models of cleanliness.

For steam yachts and launches, where cleanliness is a consideration of importance, this feature of these engines will be particularly appreciated; and for this species of service they are especially well adapted, for the reason that they have a low center of gravity.

One of the chief characteristics of these engines lies in the fact that the cylinders do not stand directly over the center line of the crank shaft, but are located to one side, a distance equal to one half the crank radius, which gives a more advantageous action of the connecting rods upon the crank. This fact will be apparent from a study of the diagram (Fig. 2) of rod angles, which will be understood from the following explanation: The heavy line A B represents the center line of the cylinder, and the point C the center of the crank shaft. It being understood that the steam acts only on the downward stroke of this engine, the rod in rising has no work to perform except to raise the piston. The heavy line 1 1 represents the position of the connecting rod at the commencement of the downward stroke, the crank moving in the direction of the arrow. Its extreme angular vibration is shown at 2 2, at which the greatest pressure is exerted upon the crank; while 3 3 indicates the release, or point at which the annular exhaust opens; and 4 4 the position at the end of the stroke. The lighter lines, 5 5, 6 6 and 7 7, indicate the various positions of the rod during the up-stroke when the rod performs no work. It is a somewhat curious fact that this engine, geometrically speaking, has no dead centers.

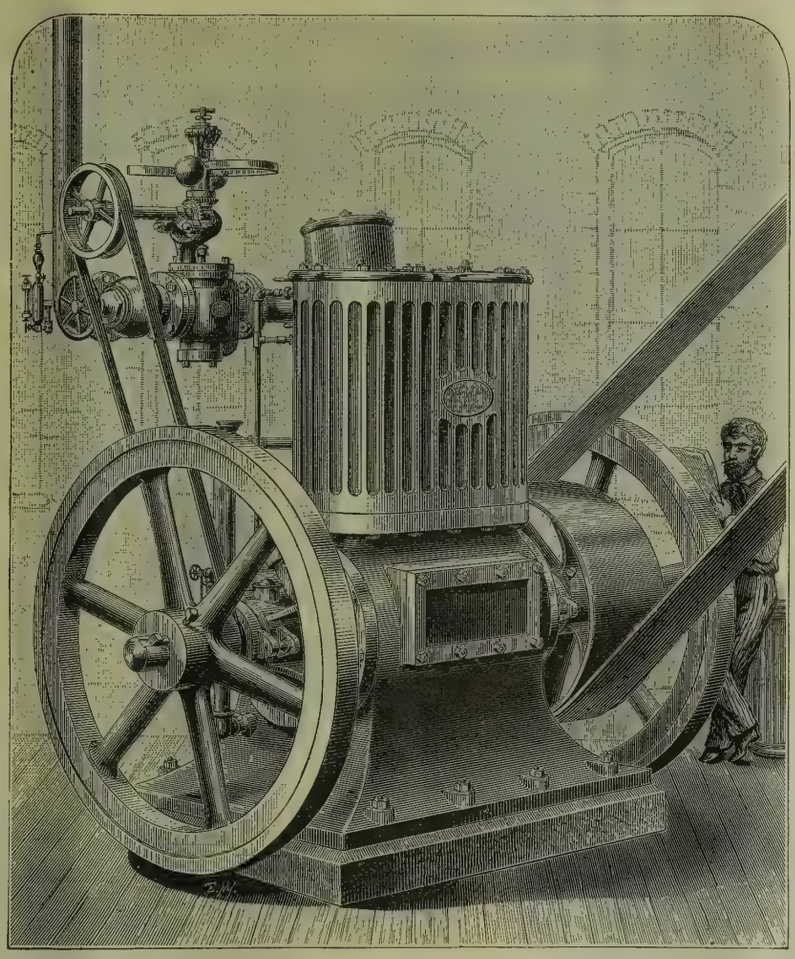


Fig. 1.—THE IMPROVED WESTINGHOUSE HIGH-SPEED ENGINE.

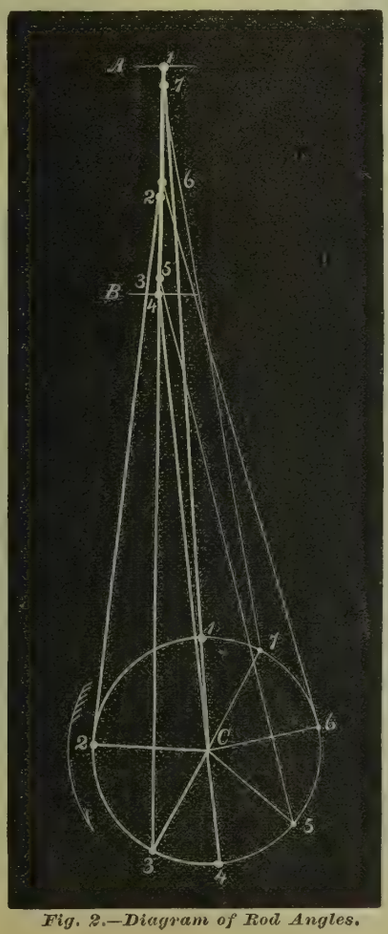


Fig. 2.—Diagram of Rod Angles.

By this construction, the rod, when working, transmits the force with much greater effect to the crank than if the cylinders were central, which would bring the rod at a greater angle. This lessening of the rod angles decreases the lateral thrust of the cranks against their journals as well as that of the piston (which is one quarter longer than the stroke) against the cylinder, so that the practical result is a great reduction of friction.

Other details of interest are the annular exhaust (described in our previous article), by which back pressure at high speed is wholly avoided; and the perfect balancing of the valve, which is set to cut off at from one-quarter to one third of the stroke, which cannot be done with the ordinary slide valve and a single fixed eccentric. The fly-wheels are turned inside and out, to insure perfect balance. Any leakage of the valve can be discovered by stopping the engine, removing the cover on the valve chest, and turning on steam. All parts of the engine are readily accessible, and the whole design is characterized by extreme simplicity. The makers, before sending out an engine, attach it to a boiler and run it for ten consecutive hours under full load, and under a boiler pressure of 90 pounds; it is then taken apart, examined for defects, and the parts are reassembled and put together.

The makers are the Westinghouse Machine Co., of 92 and 94 Liberty street, New York.

A Curious Disease.

It has been observed that the manufacture of bichromate of potash has a singular effect upon the nose, manifesting itself in a curious manner. A little hole is formed on the septum or partition of the nose dividing the nostrils, and increases gradually until the partition entirely disappears, with the exception of its lower part, so that to a superficial observer there is nothing the matter with the nose, except a little outward depression. As soon as the partition is destroyed the process appears to stop there, neither the lungs, air tubes nor throat being in the least degree affected. Some workmen at the chrome factory in Russia, where the disease has been chiefly watched, have been employed for ten years and remained unaffected, while with others the hole in the nose begins to be formed after one month's work. But that the disease is something more than an individual peculiarity is evident from the fact that an inspection of all the hands proved that more than 50 per cent of the men had diseased noses. The early symptoms are a slight tickling of the part affected, followed by bleeding, but with no uncomfortable feelings, and, in fact, the destructive process is painless.

Hollow Steel Shafting is being introduced into France. It is made by casting the metal round a core of lime, the ingot being finally rolled into shafting, the lime core going with it, and diminishing in diameter in the same proportion as the metal, even when the total diameter is reduced as low as ¼ inch.

Power Scales, or Dynamometer.

BY JESSE H. LORD.

A number of attempts have been made to construct a power measurer which should give absolute results in foot-pounds, but most of them had some inherent defect, either in construction or application. Some have depended upon springs for efficiency, others have been intended for fixtures; most of them gave only relative results, and none of them were simple, portable, easily applied attachments. So many mechanics insist on a resort to the Prony brake as preferable to any and all so-called improvements. Yet a good dynamometer is unquestionably to be desired, as a useful instrument to the manufacturer, millwright, the leasor, and to the hirer of power.

James Emerson, of Willimansett, Mass., has perfected a power scales that appears to possess all the requisites desired. Unlike most other power measurers, this demands no change in the machine or shaft to which it is applied, beyond the removal of one of the pulleys, if a tight and loose pulley are used, the pulley arms serving as means of propulsion or actuation of the power measurer. No springs are used on the machine, and all the movements are direct and absolute. No comparison with some other standard is required, as this machine gives absolute results instead of relative indications. In short, it is a power scales, and really weighs the strain, resistance, friction, or inertia, just as truly as the Fairbanks scales weighs the gravity of a load; and, like the Fairbanks scales, this may be considered a standard. The elements of its operation are, speed of the machine, to be weighed or measured in feet, and resistance of the machine in avoirdupois pounds. Both these data are given by the appliance at the same time, and both are represented in plain figures. The result of the two multiplied together is the number of foot-pounds, which may be easily reduced to horse-power or its fractions, if this is desired.

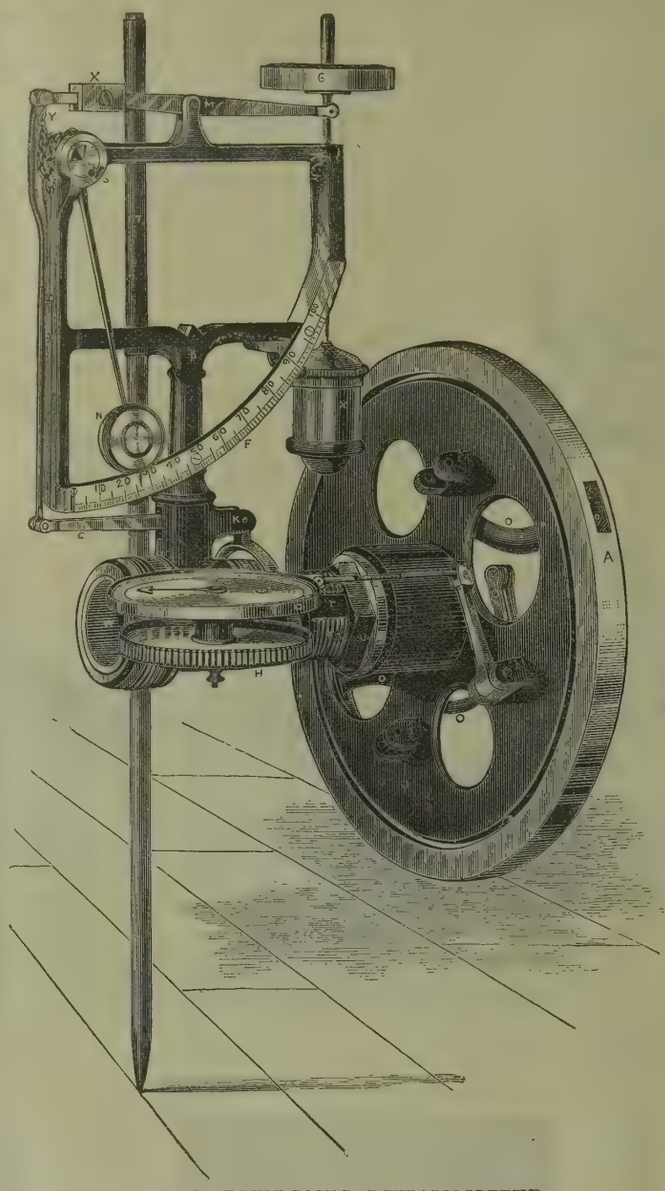


Fig. 1.—EMERSON'S DYNAMOMETER.

Fig. 1 represents the power scales detached, and Fig 2 shows it attached to a machine from which the loose pulley has been removed, and the tight pulley is made a loose pulley by having its set-screw slacked up or its key removed. The utility of this remaining pulley is to receive the driving belt, that the machine to be tested may be run at its normal speed.

The power scales has a disk of 12 inches diameter, to which, and its hub, all the attachments are made. It is secured to the end of the shaft of the machine to be tested, by means of a split threaded sleeve with wedge-shaped jaws, formed to fit shafts from ¼ of an inch diameter to 1⅝ inches diameter, and the adjustment requires but two or three minutes of the time of an intelligent workman. In fact, the adjustment of the power scales is similar to that of an object to be bored in the jaws of a lathe chuck.

In Fig. 1 some of the letters of reference may be of use; the levers O are pivoted at A in the disk, and connect with the arms of the driving pulley, or, if the pulley has a solid web, with the sides of holes drilled through the webbing. The object is simply to give a rotary and "bearing" motion and resistance to the levers, which by bell cranks connect with an annular collar on the power scales, so as to actuate the lever C by the yoke K, that gives movement to the pendulum N. This connection between the rotating movement of the shaft of the machine to be tested, and the reciprocating motions of the pendulum and the lever C, is similar to that of the old-fashioned throttle governor of the steam engine, and can be readily understood by all mechanics.

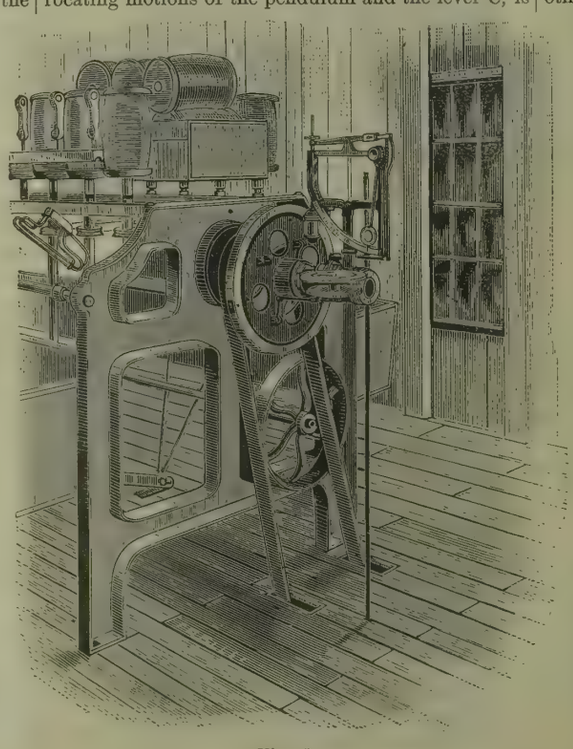


Fig. 2.

The marking scale beam of this power measurer is exactly like that of the Fairbanks scale in principle, being modified only by having a pendulum instead of a *pois*, and being a quadrant instead of a straight line. The letters show how adjustment for perfect balancing can be made; G shows how weights may be added to increase the capacity of the power scales, this 12-inch size being capable, at 1,000 revolutions per minute, of weighing up to 25 horse power, other speeds proportionally; and the letters W and H show the method by worm and gear of getting the number of revolutions of the machine to be tested. A staff T, or a pointed bar, is used to rest on the floor to prevent the friction of the shaft from moving the pendulum and scale out of a perpendicular, and the dash-pot X combines with the adjuster-block X to prevent undue oscillation of the pendulum.

The total weight of this size apparatus is so slight that it may be carried easily under the arm, and its readiness for use is such that ten minutes is amply sufficient to apply and adjust it. No previous schooling or drill is required to enable an overseer or foreman to apply this power scales, as is necessary in indicating a steam engine; and yet this apparatus is intended to do for the manufacturer, and for the hirer and the leter of power, what the indicator does for the proprietor of steam power—give the facts about the amount of power used and its cost; and this it does with accuracy.

Steam Jackets.

At a recent trial of an engine made in Belgium on the Corliss system, the following details are given concerning the efficiency of the steam jacket: Working under average conditions, without the jacket, the engine developed 127.6 horse-power, with a consumption of 24.7 pounds of steam per indicated horse-power her hour. With precisely the same opening of the valves, and under otherwise exactly similar conditions, except that steam was admitted to the jacket, the work rose to 157.13 horse-power, and the consumption of steam fell to 19.85 pounds per indicated horse-power per hour, making in this way a gain of 19.6 per cent. A somewhat defective action of the steam traps existed the day on which these results were recorded. This trial was repeated the following day, and the consumption of steam fell to 18.96 pounds per indicated horse-power per hour, making a gain of 23½ per cent, the amount of power being sensibly the same. Comparing the mean of these two days' work, the same engine did 23.7 per cent more work with the jackets than without, while the saving of steam per indicated horse-power per hour was 21.6 per cent by the use of the jacket.

Long Bridges.

Mr. K. Pfarski has made a list of the longest bridges at present existing, which are the following, their lengths being in meters—about 3 feet 3⅜ inches: Parkersburg Bridge, 2,147; St. Charles Bridge, over the Missouri, 1,993; Ohio Bridge, near Louisville, 1,615; bridge over the East River, 1,500; Victoria Bridge, over the St. Lawrence, 1,500; New Volga Bridge, near Syssran, 1,485; Holland's Diep Bridge, near Moerdyk, 1,479; bridge over the

Pongabuda, near Gooty (India), 1,130; Dniester Bridge, near Kiew, 1,081; Rhine Bridge, near Mainz, 1,028; Dnieper Bridge, in Pultowa (Russia), 974; Mississippi Bridge, near Quincy, 972; Missouri Bridge, near Omaha, 850; Weichsel Bridge, near Dirschan, 837; Danube Bridge, near Stadlan, 769; Po Bridge, near Mezzana Corti, 758; Tamar Bridge, near Saltash, 665; Leck Bridge, near Kuilenberg, 665; Mississippi Bridge, near Dubuque, 536; bridge over the Gorai River (India), 529; Britannia Bridge, near Bangor, 464; Saane Bridge, near Freiburg, 382; Theiss Bridge, near Szegedin, 355. The new Volga Bridge, near Syssran, is accordingly the longest in Europe.

Proportions of Riveted Joints.

[*Continued from page* 202.]

We present herewith, on the authority of the Hartford Steam Boiler Inspection and Insurance Company, the following additional considerations upon this important subject, which we esteem to be of special value.

In the previous articles of this series we omitted to mention the fact that we were indebted for the cuts and data to the above company, who are entitled to the sole credit for the matter, having brought it before the public in their monthly publication, the *Locomotive*, after a considerable expenditure of time and at large expense.

The cuts shown in our recent issues represented better practice than the average. They were selected from the proportions of the best and most prominent manufacturers only. The general practice in the greater number of shops was shown in Figs. 1 and 2, where the pitch is the same in both single and double riveted plates. The practice cannot be too strongly condemned, and it is strange that such a system can find followers anywhere among intelligent boiler-makers.

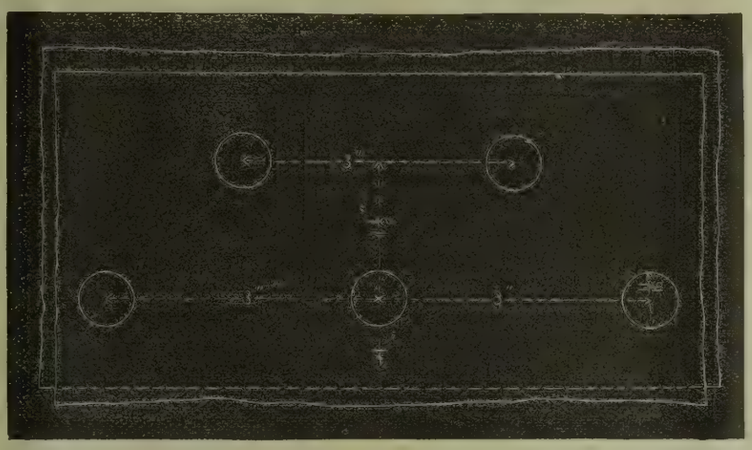


Fig. 14.

Having shown the great diversity of practice in proportioning riveted joints, the question arises, What are the best proportions for the different thicknesses of plate? We have shown that the strongest form of joint is seldom realized in practice, and that double riveting is invariably badly proportioned. Different reasons are given for this wide departure from the strongest proportion, the principal one being the impossibility of making a tight joint with wide pitches. Now, we maintain that tight joints can be made with much wider pitches than are generally used, for we know of several places where it is done without any trouble whatever. If ordinary skill is used, there will be found no trouble whatever in using 3-inch pitch for a double riveted joint in a quarter-inch plate.

Another strong argument in favor of the widest possible pitch, is the fact that more metal remains to resist the effects of corrosion, which always affects the plate more than it does the rivet. All things being equal, the life of the boiler will be greater in proportion to the amount of effective material we have to resist deteriorating influences.

After extended observation and mature reflection, we have arranged the following scale of pitches and rivet diameters for different thicknesses of plates. It will be noticed that the distance between the two rows of rivets in the double riveted joints is such that the distance from the center of any rivet in one row to the center of the next rivet in the other row is about equal to the pitch in single riveting. This is an important point, and should never be overlooked. By this means we get the advantage of the staunchness due to a small pitch with the extra metal and greater strength of the wider pitch. We give cuts of the proportions, with calculations of their efficiencies, and invite careful consideration of them, and candid criticism if any one is disposed to be critical.

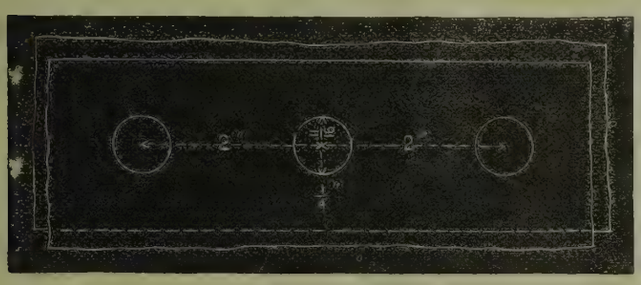


Fig. 13.

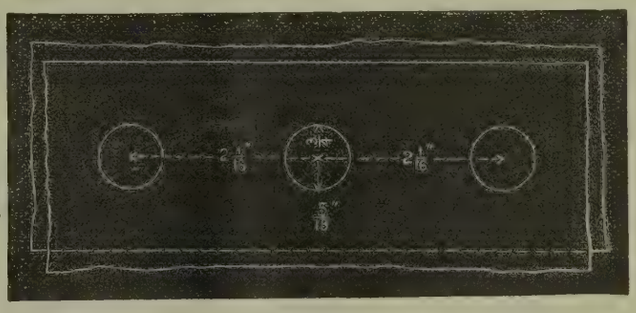


Fig. 15.

Referring to Fig. 13, we have, plate, $\frac{1}{4}$ inch thick; rivet hole, $^{11}/_{16}$ inch diameter; pitch of rivets, 2 inches. Strength of plate at joint $= \frac{2-.6875}{2} = 66$ per cent of solid plate.

Strength of rivets at joint $= \frac{.37122}{\times .25} = 74$ per cent of solid plate. Strength of rivets at joint $= \frac{.37122 \times 2}{3 \times .25} = 99$ per cent of solid plate.

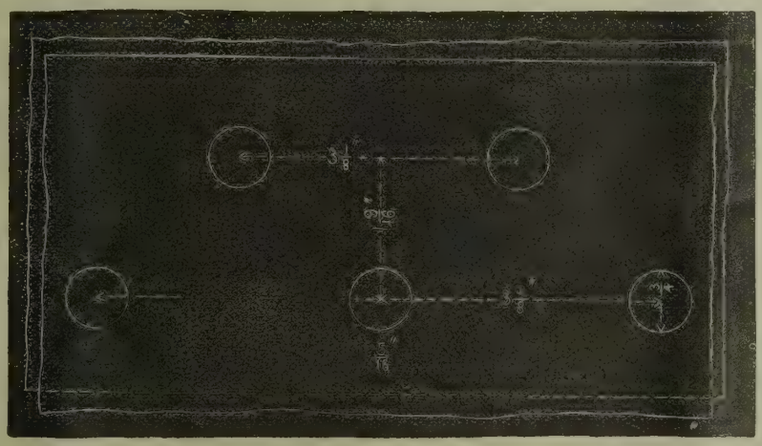


Fig. 16.

Fig. 14.—$\frac{1}{4}$-inch plate, double riveted. Rivet holes, $^{11}/_{16}$ inch; pitch of rivets, 3 inches.

Strength of plate at joint $= \frac{3-.6875}{3} = 77$ per cent of solid plate. Fig. 15.—$^{5}/_{16}$ inch plate, single riveted; rivet holes, $\frac{3}{4}$ inch diameter; pitch of rivets $= 2^{1}/_{16}$ inches.

Strength of plate at joint $= \frac{2.0625-.75}{2.0625} = 64$ per cent of solid plate. Strength of rivets at joint $= \frac{.44179}{2.0625 \times .3125} = 68$ per cent of solid plate.

Fig. 16.—$^{5}/_{16}$ inch plate, double riveted; rivet holes, $\frac{3}{4}$ inch diameter; pitch of rivets $= 3\frac{1}{8}$ inches. Strength of plate at joint $= \frac{3.125-.75}{3.125} = 76$ per cent of solid plate Strength of rivets at joint $= \frac{.44179 \times 2}{3.125 \times .3125} = 90$ per cent of solid plate.

[*To be Continued.*]

Novel Way of Clearing a River.

The work of dragging or harrowing St. Helen's Bar, at the mouth of the Columbia River, having been abandoned as practically useless, and the government appropriation not being available for some weeks, so that the government dredge could not be utilized, a new means of deepening the channel was devised and put in operation, concerning the results of which a very favorable report has been received. The theory was that if the sand of which the bar is formed, could be kept in suspension by the motion of a steamship's propeller, the current of the river would carry it out to sea. The scheme was considerably ridiculed by most of the river and ocean captains and pilots, but as the sand of the bar is very clean and light, and the current of the river runs two miles per hour at ebb and three at flood tide, Mr. Prescott, Manager of the Oregon Railway and Navigation Company, felt sufficient interest in the experiment to offer the use of the company's steam collier "Walla Walla" in making it. Under the supervision of Messrs. Gates and Holland, the mechanical engineers of the Oregon Railway and Navigation Co., the steamer was moored on the bar, bow up stream, the stern at the lower edge of the bar, and loaded so that the keel touched the bottom. In eighteen hours' actual work a channel 1,000 feet long and 100 feet wide was deepened from a maximum of 18 feet to from 22 to 24 feet. The steamer, after completing and straightening the channel the whole length of the bar, will be sent to Walker's Island for similar work. Mr. Prescott speaks enthusiastically of the success of the experiment, which he regards as having solved the problem of keeping the river clear of obstructions.

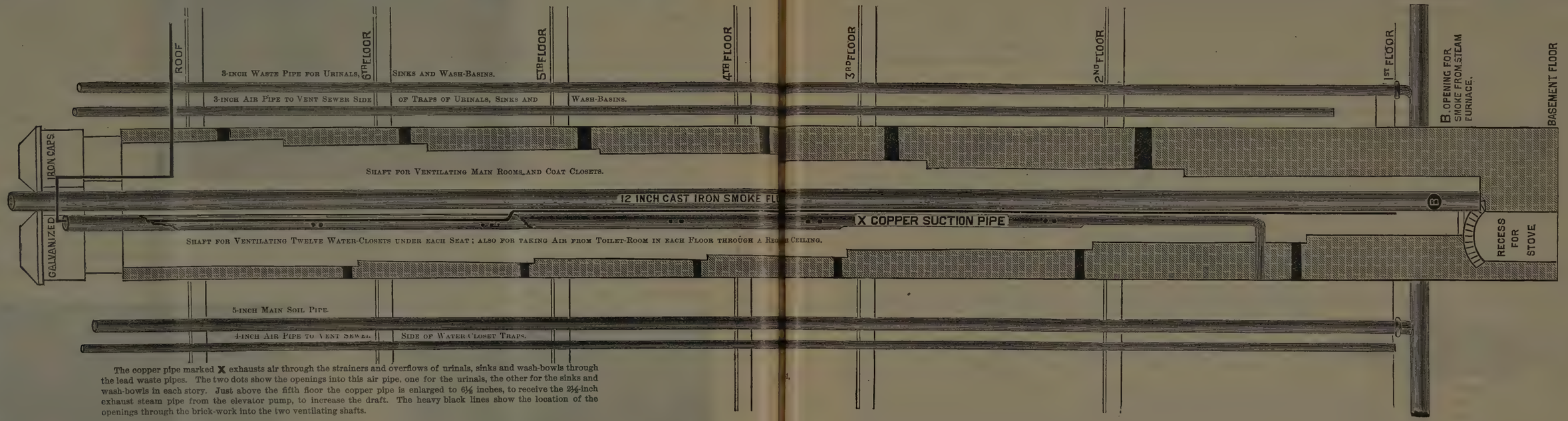
New Methods of Ventilation.

Some noteworthy improvements have just been completed at 51 and 53 Leonard street, in this city, in a store owned by a well-known dry-goods commission firm, Messrs. Minot, Hooper & Co., who occupy the first floor for their own business. The convenience and healthfulness of the toilet-rooms and sanitary appliances, the many novel inventions introduced, and the remarkably successful plan of ventilation adopted, make the building especially convenient and attractive for mercantile purposes.

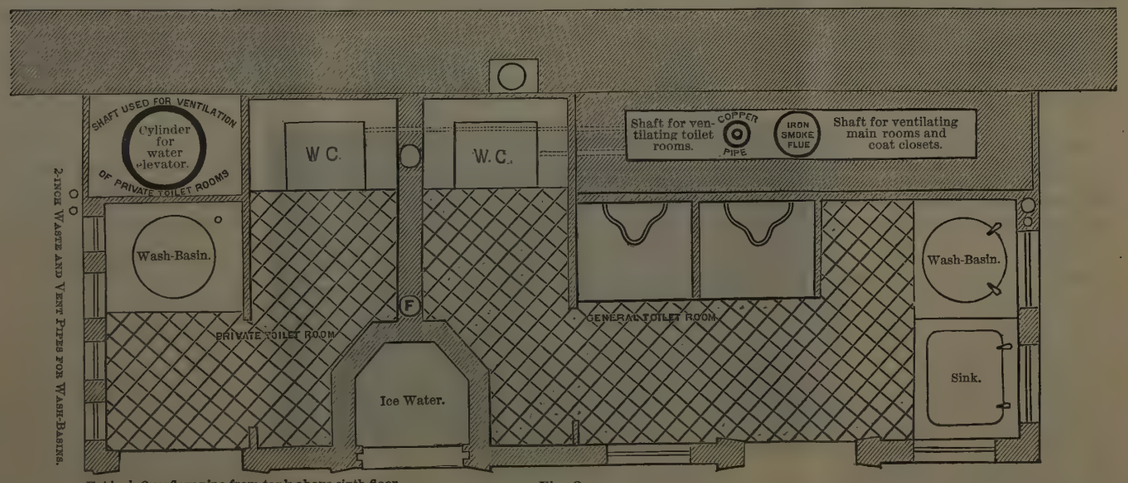
It was erected about fifteen years ago as two separate stores, but within the past six months the two have been united by wide openings through the walls on every floor, so as practically to form one structure, which has been so nearly rebuilt that hardly anything remains of the old work, except the exterior walls and floor timbers. A swift-running Otis hydraulic passenger elevator, with a freight car beneath, has been put in, and the sixth floor is now as quickly reached from the sidewalk as the first landing was before the alterations were made. Boilers in the basement furnish steam for heating every story, and the smoke flue from these boilers is an important adjunct to the plan of ventilation.

The upper floors, formerly used only for the storage of merchandise, have been handsomely fitted up for salesrooms and offices, and in the sixth story, which overlooks the adjacent buildings, windows have been cut in the sides and skylights opened in the roof. This floor, with its abundance of light and accessibility by means of the elevator, is undoubtedly one of the finest in the city for business purposes. In addition to the elevator, the lofts are reached by a wide staircase starting from a handsome vestibule, which is one of the attractions of the building. On every floor conveniently arranged toilet-rooms and coat closets have been built. Among the many novel conveniences introduced in the building, one of the first to be noticed by the visitor is the number of clock dials, of which several are to be seen in every story. By means of iron pipes, they are all connected with one large regulator, and at the end of every minute the hands of fifty dials in this and stores adjoining are moved by an impulse of air through the tubes. This invention, known as the pneumatic clock, has been but recently introduced in this city.

The automatic arrangement for closing the elevator doors, designed and patented by Mr. T. M. Clark, is a great improvement over former methods. Many such devices have been tried for opening and closing doors or gates to the elevator, and some of them work well on slow-running freight elevators, but it has been found unsafe to use them with an elevator running at a speed of 200 or 300 feet per minute. With this arrangement the door is opened by the person running the elevator, but as the elevator leaves the floor, it releases a spring, and the door is at once gently closed. The time of the operator is saved, and there is no chance of the door being left open by neglect. The operator has control over the door on the opposite side of the car from where he stands, by means of a lever like those in use on the one-horse street cars.


ROOF
6TH FLOOR
5TH FLOOR
4TH FLOOR
3RD FLOOR
2ND FLOOR
1ST FLOOR
BASEMENT FLOOR
3-INCH WASTE PIPE FOR URINALS, SINKS AND WASH-BASINS.
3-INCH AIR PIPE TO VENT SEWER SIDE OF TRAPS OF URINALS, SINKS AND WASH-BASINS.
IRON CAPS
SHAFT FOR VENTILATING MAIN ROOMS AND COAT CLOSETS.
12 INCH CAST IRON SMOKE FLU
X COPPER SUCTION PIPE
GALVANIZED
SHAFT FOR VENTILATING TWELVE WATER-CLOSETS UNDER EACH SEAT; ALSO FOR TAKING AIR FROM TOILET-ROOM IN EACH FLOOR THROUGH A REGISTER CEILING.
B. OPENING FOR SMOKE FROM STEAM FURNACE.
RECESS FOR STOVE
5-INCH MAIN SOIL PIPE.
4-INCH AIR PIPE TO VENT SEWER SIDE OF WATER-CLOSET TRAPS.

The copper pipe marked **X** exhausts air through the strainers and overflows of urinals, sinks and wash-bowls through the lead waste pipes. The two dots show the openings into this air pipe, one for the urinals, the other for the sinks and wash-bowls in each story. Just above the fifth floor the copper pipe is enlarged to 6¼ inches, to receive the 2½-inch exhaust steam pipe from the elevator pump, to increase the draft. The heavy black lines show the location of the openings through the brick-work into the two ventilating shafts.



F 4-inch Overflow pipe from tank above sixth floor.

Fig. 2.

As a safeguard against accidents from starting the elevator, when parcels are being put on or off the freight car, which is below the passenger car, it was thought desirable that the person running the elevator should be able to see into the lower car. This he is enabled to do by means of a tube like a telescope running through the floor of the car, with a mirror fixed at the proper angle underneath it. The tube can be turned so that the mirror will reflect successively the different parts of the freight car. Zimdar's pneumatic bells are used on the elevator, and also in other parts of the building; they are preferred to electric bells, as the annoyance of chemicals is avoided. The freight elevator which runs from the sidewalk to the basement, has an automatic safety gate attachment, which is a most useful device, and should be adopted by every firm using these sidewalk elevators. As the platform goes down, the gate rises, so as to protect the only side exposed, thereby preventing the most heedless passer-by from falling down the shaft.

Powers' patented device was applied to all the ceilings throughout the building. By this plan the heavy coats of plaster are firmly held by brass wires crossing each other at short intervals, and fastened to the furring strips by galvanized nails that will not rust. Ceilings thus secured are not disturbed by heavy jarring overhead, and hold their place when, as in the case of fire, they are thoroughly saturated with water. The finishing coat just covers the wires, so that they are not exposed to view.

But the remarkable feature of this building is the system of ventilation, which was planned with much care and ingenuity, and which, in some respects, is quite novel. A perfect system of ventilation must of course provide for the ingress of pure air as well as the egress of foul air. In this case the result desired is accomplished as follows: At the front and rear of each floor, out-door air is introduced into the steam radiators, which are so made that the base forms an air chamber, instead of being set upon legs in the usual way. Fresh air, warmed in winter, is thus introduced into the building continuously through the year, night and day, being drawn in by the power applied for exhausting the air from the building. On the other hand, the constant withdrawal of air is effected through openings on every floor into a brick shaft running to the top of the building, a strong draft being maintained in the shaft by the heat radiated from the 12-inch iron smoke flue of the steam-heating boilers in the basement, and by several other appliances. During the summer, when the boilers are not used, a stove at the bottom of the shaft supplies the necessary heat. One feature of this shaft which is an important factor, is its gradual increase in area from 3 square feet at the base to 9 square feet at the top. This mode of construction is very important in securing an equal flow of air from every story. When a shaft is equal in size throughout, some stories get the advantage over others. Galvanized iron hoods cover the top of the shaft, preventing down drafts. The exhaust steam from the elevator pumps, and also the gas lanterns which light the toilet-rooms, are arranged so as to materially increase the draft. A test of the strength of the current showed an unexpectedly favorable result, the anemometer registering a velocity of from 250 to 360 lineal feet per minute, indicating a capacity for removing over 150,000 cubic feet of air from the building every hour.

By means of a copper tube gradually increasing in area, heated by the smoke flue, the exhaust steam pipe and an argand gas burner, and connected with the outlets to the wash-basins, sinks and urinals just below the strainers, a constant current is maintained downward through the strainers, so that these fixtures all act as auxiliary ventilators to the registers opening into the brick shaft. Not only is the escape of sewer gas prevented, should any succeed in passing the traps, but the short length of pipe between the strainers and the traps is kept entirely free from the foul air found there in ordinary plumbing, and which, by this system, constantly passes off through the roof to the outer air, instead of remaining to be forced out into the room whenever the water is turned on. This plan was adopted at the suggestion of Mr. Clark and Mr. Duggan.

Fig. 1 is a sectional view of the ventilating shaft, and Fig. 2 gives a plan of the toilet-rooms, showing the location of the shaft.

The toilet apparatus throughout this building has not only been rendered entirely harmless, but it has been made an active agency in the plan of ventilation.

It is a source of great satisfaction to find that the flame of a torch is almost extinguished by the force with which it is drawn into the shaft from the openings just under the seats of the water-closets; but to see the flame drawn into all openings in the urinals, sinks and wash-basins to the depth of several inches is a novel experience to all who have witnessed it. The water-closets are all of the hopper pattern, arranged with seat attachments, which provide a constant flow of water as long as the apparatus is in use. The coat closets, as well as all the small closets under sinks and wash-basins, are connected with the main shafts, so that by openings in each closet door, fresh air is made to flow continuously through them all, making them quite odorless instead of being, as they usually are, the source of much annoyance. Lead safes are provided under all the apparatus above the basement, and to prevent any possible overflow of water into the rooms, the tile floor of each lavatory is made to pitch slightly towards one of the lead safes. Water falling on the tiles anywhere, would by this means find its way to an open sink in the basement.

If it is desired to introduce these arrangements in private dwellings, where sufficient power cannot be otherwise secured, the necessary propulsion may be obtained by a self-feeding stove in the cellar, or by a gas or oil lantern, or both together.

The general features of this system of ventilation are those successfully employed for many years past by Mr. Henry A. Gouge. This gentleman has had great experience in such work. The plan of shafts gradually increasing in size, and several other devices used in this building, have been patented by him.

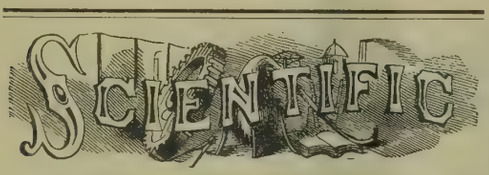
The wash-basins are provided with both hot and cold water, the hot water coming from a tank in the basement heated by exhaust steam. Croton water is pumped into a tank on the roof for the wash-basins

and sinks in the upper stories, and another large tank on the roof, supplied from a well sunk in the basement, furnishes an abundance of water for flushing the water-closets and urinals. The latter are connected with an automatic device by which they are thoroughly cleansed by a quick flush of well-water every three minutes.

The basement is protected against dampness and ground air by a heavy coat of rock asphalt laid over concrete; above this is a brick pavement, laid in cement, and over the brick is placed the wooden floor, laid on locust planks. The asphalt extends two feet up on the side walls. To prevent damage to goods from an overflow of water upon the cellar floor, an outlet is made through the asphalt to a large space beneath filled with small stones.

The progress of the sanitary work has been watched with much interest by builders and others who have been conversant with it, many of whom have expressed their opinion that the completed structure will be regarded as a model to be followed by persons who appreciate the luxury of breathing fresh air in their homes and places of business.

Mr. J. Morgan Slade, of New York, and Mr. T. M. Clark, Professor of Building and Architecture in the Massachusetts School of Technology, were the architects; Messrs. Alfred C. Hoe & Co., builders, have had general charge of the work; Bates & Johnson furnished the heating apparatus; the plumbing was done by T. H. & E. Duggan and Oliver Barratt; the mason work by William G. Slade; the iron work by Lindsay, Graff & Megquier; and the tile floors by the American Encaustic Tiling Co.



Association Notes.—The reports concerning the recent meeting of the American Association for the Advancement of Science, at Montreal, all agree in pronouncing it to have been a very successful and satisfactory meeting. The attendance was very large, and no less than 256 papers were listed, many of which represented valuable contributions to science. The meeting was under the presidency of Dr. J. W. Dawson, an eminent Canadian geologist.

The address of the retiring president, Prof. G. J. Brush, of Yale College, was one of the most interesting features of the meeting. The subject was "The Progress of American Mineralogy," and the speaker traced the gradual growth of interest in this fascinating science, through the efforts of such pioneers as Bruce, Gibbs, Cleaveland, the elder Silliman, Dana and others.

Of the 250 papers, or thereabouts, that were read before the various sections (nine in number), we can only call attention to a few of the more important ones that appear to us to be of general interest or special importance.

The Section of Geography and Geology was, as usual, more fully represented by scientific papers than any other. Perhaps the most generally interesting paper read before this section was by Dr. W. B. Carpenter, on the "Temperature of the Deep Sea.' He explained that the difficulty of obtaining accurate results in such measurements heretofore had been on account of the disturbing element of the enormous pressure on the glass bulbs of thermometers at great depths, by which the indications of the instruments were made greater than they should be. To avoid this source of error, the Miller-Casella thermometer had been devised, by which a pressnre of five tons per square inch could be borne without sensibly affecting the recorded temperature.

Observations made with such an instrument in various localities, had demonstrated that the opinion heretofore generally entertained that the ocean temperature at great depths was uniformly the same (about 39° Fah.,) was incorrect. He found, for example, that the temperature of the deep basin of the North Atlantic was 35° Fah., while in the Faröe Channel, within 100 miles of Scotland, the temperature was 29.5°, showing that the channel in question was a branch of the Arctic current. Again, the temperature of the Mediterranean Sea was found, at the depth of 2,500 fathoms, to be uniformly 55°. Other curious differences were noted. He noted that the Arctic and Antarctic underflows meet about the region of the Equator, where they rise nearly to the surface as a cold current, so that while the surface temperature may be nearly 80°, at 300 feet below it falls to 35°.

A paper of special interest to geologists was presented by Prof. Henry Carvill Lewis, on "The Terminal Moraine across Pennsylvania." The southern limit of the great ice sheet that covered the northern portion of this continent during the glacial period, has been identified by tracing the course of the great mass of detritus, the moraine, which it left behind as it receded. The termination of this moraine has been located in many places, having been traced from Cape Cod, where it begins, across Rhode Island, Long Island, New Jersey, and into New York. It has also been located and traced across Ohio, Indiana, Illinois, Wisconsin, Minnesota and Dakota. Prof. Lewis claims to have succeeded in tracing it in Pennsylvania for a distance of 400 miles across the great divide between the Atlantic and the Gulf of Mexico. Prof. Lewis' discovery completes the line of the moraine, by filling out an important gap hitherto missing. He stated in his paper that the dividing line between the glaciated and non-glaciated areas were often so sharply defined that it was possible to stand with one foot on a striated rock and the other on one that the ice had not touched. The interest in this paper was very general, and it gave rise to considerable discussion.

Dr. Haughton presented a paper containing some ingenious speculations as to the condition of the earth and moon when thrown off from the solar nebula. By parity of reasoning from the comparison of Saturn's rings, which are most probably composed of an aggregation of meteoric stones; from the low density of Jupiter and the outer planets; from the recent researches into the nature of meteoric showers and comets, etc., he held it to be probable that when the earth and moon were cast off from the solar nebula, they were in the condition of a swarm of meteoric stones, each having the temperature of interstellar space—that is to say, about 460° Fah. below the freezing point of water.

Prof. A. Graham Bell described some recent improvements which he had made in the construction of an instrument for locating the position of bullets in wounds. The general interest aroused by the effort to locate the ball lodged in the body of our late President, by means of an instrument that Prof. Bell had devised, will be recalled by all of our readers. The attempt, as will be remembered, was unsuccessful; but Prof. Bell claims now to have succeeded in so improving his instrument that he is confident of obtaining more exact results.

Prof. C. A. Young, of Princeton College, described the new 23-inch equatorial that has just been erected in the observatory of the college, and which he claimed to be the most nearly perfect instrument in this country, if not in the world.

Mr. W. Le Conte Stevens read a paper on "The Influence of the Electric Light on Binocular Vision," in which he called attention to the fact that where the conditions of the experiment were such as to bring no muscular strain on the eye, a single electrical spark was found to be sufficient to enable the binocular image on the retina to be interpreted with proper stereoscopic effect.

In the Chemical Section, a paper of practical interest was read by Mr. G. C. Caldwell, on "Pemberton's Method for the Volumetric Estimation of Phosphoric Acid," in which the author spoke favorably of the method. Prof. Geo. F. Barker made some interesting observations on "Secondary Batteries," with special reference to the economical production of electricity for purposes of illumination.

Mr. Hovey, who is well known as an enthusiastic cave explorer, read a paper on the subject of "Subterranean Map-Making," in the course of which he exhibited completed maps of the Mammoth and Luray caverns, made from careful surveys.

The above summary, though very incomplete, must suffice for the purpose of our review.

Prof. C. A. Young, of Princeton, was chosen President for the coming year, and Minneapolis was chosen as the place for holding the next annual meeting.

Value of Vivisection.—Mr. G. F. Yeo, a Fellow of the Royal Chemical Society, and Professor of Physiology in King's College, lately delivered a remarkable lecture before the Royal College of Surgeons, which was devoted to a *résumé* of the benefits to humanity and to scientific surgery and medicine derived from experiments upon living animals, usually called "vivisection," against which, owing to the clamor of ignorant sentimentalists, stringent and ridiculous laws have been enacted in the United Kingdom.

The lecturer presented a great number of illustrations to prove the inestimable value to suffering humanity of experiments conducted on living animals, of which, however, we have only space to select one by way of a striking illustration. There are many operations which have been performed on the stomach, and the other abdominal viscera, which are the outcome of vivisection. Thirty years ago Sedillot was tempted by the facility with which Blondlot established gastric fistula in dogs, for the purpose of making experiments in digestion, to perform a similar operation on a human being. Having under his care a case of cancer of the œsophagus, in which life was threatened from inanition, he determined to open the stomach. He did so successfully, and with excellent results to the patient. Since then Billroth has removed a portion of the stomach for cancer, and Czerny has removed a cancerous tumor involving the pylorus of a patient, who was rapidly sinking from occlusion of outlet of the stomach and constant vomiting. In the last remarkable case the patient rapidly recovered, and resumed his usual occupation in little more than a month. A similar case, treated with equal success, is that of a robust young girl who had so seriously injured the œsophagus by reason of having swallowed, by mistake, a corrosive poison, that it was nearly impossible to introduce food into the stomach, either by natural or artificial means, and death by slow starvation was imminent.

By experiments on dogs it was ascertained that by securing the union of the serous surfaces, a portion of the intestine could be removed and the ends of the remaining portion sewn together so that the peritoneal surfaces united. This fact has since frequently been successfully made use of in treating the human patient, and many wounds or diseases involving the intestines, which were formerly invariably fatal, have been cured.

These examples, which we might multiply indefinitely from Yeo's most instructive lecture, are sufficient of themselves to refute the extravagant statement of the anti-vivisectionists, that "not one benefit has accrued from the labors of the physiologist, either to medical or surgical science," and to demonstrate the ignorance and folly of their unreasoning and sentimental crusade against scientific experiments upon living animals in the interest of humanity.

Peroxide of Hydrogen as a Bleaching Agent.—This substance is at present attracting attention by reason of its introduction on the commercial scale for bleaching and disinfecting purposes. It is found to be a very energetic bleaching agent for animal substances, such as hair, feathers, bones, ivory, etc.,

possessing many advantages for this purpose over chlorine. The energetic bleaching properties of this agent have long been known, but the cost of its preparation has hitherto excluded its introduction for general industrial uses. This objection is said to have been largely obviated, and the material is rapidly coming into use. It is very generally employed in France and Germany for bleaching hair and feathers; and fans, handles of walking-sticks, knife handles, etc., of ivory and bone, bleached by this substance, are already being extensively used.

For medicinal purposes, also, the peroxide of hydrogen is highly recommended, for its disinfecting qualities. Its advantages in this respect over other disinfecting agents are thus described by Dr. Ebell: (1) Complete absence of smell; (2) yielding oxygen without leaving any other residuum than pure water; (3) absence of any injurious effect on the organism. It is suggested as a useful agent in dentistry for bleaching discolored and carious teeth; and it is suggested as a substitute for carbolic acid in the form of spray in making surgical operations.

The Parasite of Consumption.—We find in the last issue of the *Popular Science Monthly* a very good summary of the experimental results of Dr. Koch, by which he claims to have succeeded in establishing the bacterial (parasitic) origin of tubercle. From this summary, which is made from a paper in the *Medical Press*, we make the following abstract:

In pursuing his investigations, Dr. Koch used material derived from both human and animal sources. He found, on examining the tuberculous material deposited in various organs, the presence of minute organisms possessing all the characteristics of bacilli, from which he was led to infer that these forms of living organisms are invariably present in such tuberculous deposits. In a multitude of cases of milliary tuberculosis, bacilli in innumerable numbers were encountered in every affected situation, and he drew the conclusion that they inevitably accompany the development at least of the disease.

To demonstrate, however, that they are the cause of the affections, required an elaborate series of investigations, which he carried out by experiments upon animals. With this object, therefore, numbers of guinea pigs, rabbits and cats were operated upon, with the results, in every case, of verifying the conclusions which the experimenter had reached. By directly transferring the tuberculous matter from diseased animals to healthy ones, by inoculation, Dr. Koch succeeded in all cases in reproducing the disease. As, however, it was still possible that the contamination might be due to a virus contained in the transferred material rather than to the presence of microscopic organisms contained in it, "cultivation" experiments were introduced and conducted on a large scale. A pabulum was found, in which the bacilli grew and reproduced freely. By repeated sowings in new quantities of the nutritive matter, extending in some cases to six months, a generation of "purified" bacilli was obtained, which could not by any possibility be accused of communicating virus.

When these cultivated organisms were introduced into healthy animals, they never failed to reproduce themselves in incalculable numbers, and to set up all the symptoms of tuberculous infection. Thus, four guinea pigs were inoculated with bacilli of the fifth generation, produced in fifty-four days from tuberculous matter originally derived from a human subject. In each case the infected animal sickened and lost flesh, and was found, when killed, to have strongly pronounced tuberculosis. This took place no matter what part of the body was chosen for the introduction of the infective material. When some animals were injected with healthy blood-serum at the same time that others were inoculated with bacilli, the latter sickened and became tuberculous, while the former were not affected.

In another series of experiments, the sputum of consumptive patients, even after having been thoroughly dried, was found to be competent to transmit the infection. Dr. Koch is still engaged on this important investigation, to determine the conditions necessary for the development of *Bacilli tuberculosi*, and other points of interest in connection with the subject.

Curious Artificial Forms of Silica, which are interesting as illustrating the structure of agates and chalcedonies, are produced by Messrs. Anson & Dankhurst in the following manner. The method would appear to be susceptible of forming an interesting lecture experiment:

A strong solution of an alkaline silicate (water-glass) is taken, containing a certain amount of alkaline carbonate, and a strong acid (sulphuric is recommended) is introduced by means of a pipette to the bottom of the vessel in which the solution is contained. Bubbles of carbonic acid gas at once arise, carrying with them a certain amount of the stronger acid. Around the stream of ascending bubbles silica is deposited by the decomposition of the alkaline silicate, and in a few minutes a tube is formed reaching from the bottom to the surface of the solution. This tube is at first very thin, and through its walls the ascending acid continues to act upon the surrounding silicate, the walls of the tube in consequence constantly increasing in thickness by the deposition of additional silica on its outer surface. As long as the flow of acid is kept up, so long does the tube increase in diameter by the deposit of successive layers, and the result is a hollow stalactite ringed in cross-sections.

The authors note that the action can be kept up until a tube of nearly one inch in diameter is formed, by forcing the acid through the walls by applying pressure to the surface, and suggest a number of means whereby the process may be varied with the same results. They then proceed to state that the natural silicious stones, like agate, chalcedony, etc., may have been formed in an analogous manner. In such minerals, where stalactitic forms occur, a central core of iron or other oxide is frequently observed, which, in the opinion of the authors, appears to represent the original tube, which has subsequently been filled up, while sometimes the cavity remains more or less completely as such. These stalactites, of course, do not grow up in regular forms, but are irregular in form, and branched more like those of coral than anything else, according to the direction taken by the gas bubbles in escaping from the end, or from points of least resistance along the sides of the tube. The authors consider that the banded stalactitic growths that occur so frequently with siliceous minerals, have been produced in a manner very analogous to the stalactitic forms produced in their experiments. They have been able, by the use of acid solutions containing various metallic and earthy salts, to cleverly imitate the coloring of natural minerals, such as jaspers, moss agates, onyx, etc.; and they conclude that under suitable conditions of heat and pressure, natural agates and allied siliceous minerals might be imitated, both in form as well as in hardness and stability.

The paper is published in full in the *Mineralogical Magazine*, current volume, to which we refer for many interesting details which we have been compelled to omit.

Precipitation of Gold from Solutions by Charcoal.—Prof. Koenig, of the University of Pennsylvania, has lately made a study of the curious fact noticed by Davis, and upon which he founds a patented procedure for precipitating gold from solutions by charcoal, in place of ferrous sulphate, as an adjunct of the chlorination process.

Prof. Koenig finds that when purified charcoal is boiled with gold chloride, the gold is deposited upon the charcoal in the metallic state, and carbonic acid is formed. Lampblack, he found, had a similar action, but it acts apparently with less energy than charcoal. The author thinks the action in question both chemical and physical, the latter depending on the surface and capillary attraction of the charcoal; as lampblack does not act physically, the chemical action depends on the combustion of the carbon to carbonic acid.

This curious action of charcoal is made use of on the industrial scale in the metallurgical separation of gold from its ores as the final result of the chlorination process, with which our readers are familiar. The solution of gold chloride is allowed to percolate through a series of tanks containing charcoal, by which the whole of the gold is retained, which covers the surface of the charcoal as though by electric gilding. The gold is obtained by cautiously burning the charcoal in suitable vessels, and subsequent fusion of the ash with suitable fluxes.

A Plea for Gaseous Fuel.—In his presidential address at the late meeting of the British Association, Dr. Siemens makes some very instructive remarks respecting the utilization of waste products, in which, taking the by-products of the gas works as an example, he shows that these very by-products, which until lately were unutilized, exceed in value the coal used by nearly $15,000,000. He then proceeds to argue from the wastefulness of the ordinary way of burning coal, in favor of the use of fuel in the gaseous state. He points out the well known fact that combustion is ordinarily very imperfect, and makes the curious statement that the soot in the pall overhanging London on a winter's day amounts to 50 tons in weight, while the amount of carbonic oxide is much greater—probably five times as much. He refers to the demonstration by Mr. Aitken that the fine dust resulting from the imperfect combustion of coal is mainly instrumental in the formation of fog, each particle of solid matter attracting to itself aqueous vapor. These globules of fog, he adds, are rendered particularly tenacious and disagreeable by the presence of tar vapor. He argues that the use of fuel gas, which he strongly favors, would correct these annoyances.

New Swedish Minerals.—Prof. L. I. Ingelström has recently described two new minerals of interest, from Wermland, Sweden.

Manganbrucite occurs at the manganese mines of the Jakobsberg, with a number of other manganese minerals. It occurs with hausmanite in granules of the size of hemp seed. It is massive, without cleavage; color, bronze-yellow to brownish-red; and translucent in thin splinters. Its constitution is that of brucite, with the substitution of 14.16 per cent of manganeous oxide. It is therefore a manganesian variety of brucite, whence the name.

Talktriplite is found at the Horrsjöberg, in Wermland, associated with lazulite, svanbergite (which it much resembles), and other phosphates. It occurs in grains of the size of a pin-head; color, yellow to yellowish-red; transparent; hardness about 5; chemical composition, a phosphate of iron (ferrous oxide), manganese, lime and magnesia. The discoverer holds it to be a triplite containing lime and magnesia, on which supposition the name selected for it is based.

Science.—M. Renan has, in an interesting passage of his own autobiography, given it as his belief that a century hence mankind will study very little else than physical science. The time, he thinks, will come when the historical sciences will be thrust into the background; all that they have to teach will be known, and men will feel comparatively little interest in their own past. On the other hand, the more they know of nature the more there will be to be known. Chemistry and physiology offer inexhaustible fields for research, and the truths which they reveal will prove more and more interesting to mankind. It is very difficult to say what men will think or do a hundred years hence; but it seems likely enough that this will be the tendency of study. Certainly, even now, the men of science are becoming more and more important factors in the life of us all.

A Curious Problem.

A correspondent of *Knowledge* having asked how much space would be required on the earth, on the assumption that, beginning with a single pair, the human race had multiplied during 5,000 years at the rate of 30 children to each pair, sons and daughters being born alternately, and each husband and wife being at the time of marriage respectively 21 and 20 years old—there being also no deaths—the editor replied that the population, taking 30 for each pair at the average age of 40 years, would be 2,199,915, followed by 141 digits, which digits might be represented without appreciable inexactness by ciphers. Now, assuming that ten persons could stand on a surface of one yard square, 30,000,000 could stand on a square mile, and on the entire earth, whose surface is about 200,000,000 square miles, some 6,000 millions of millions. Dividing the number just obtained by this, the result is 3,666,526, followed by 125 ciphers. It would require this inconceivable number of worlds like our own for the population on the assumptions made.

Let us see, says Mr. Proctor, how large a single globe would suffice to give standing room to this population, ten to the square yard. Such a globe must have a diameter exceeding the earth's as the cube root of the above quantity exceeds unity, or, roughly, as 7 followed by 43 ciphers exceeds unity. (In reality it will be larger considerably, but this is near enough in such a problem as the present). Now the diameter of the orbit of Neptune, roughly, exceeds the earth's diameter nearly 700,000 times. Hence the diameter of the required globe exceeds the diameter of Neptune's orbit more than a hundred billions of billions of billions of times. Supposing the furthest star visible in the great Rosse telescope to lie some thirteen or fourteen millions of times further from us than the nearest, which lies about 70,000 times further than Neptune, the distance of that star, 1,000,000,000,000 times further than Neptune (or a light-journey of some 40,000,000 of years), would be but the 100,000,000,000,000,000,000,000,000th part of the radius of such a globe as would be required to hold the population we are considering. A sphere having a radius equal to 100 millions of years of light journey would not suffice even to contain so many human beings.

Printing on Wood.

A machine for printing box sides and ends, instead of stencilling, and doing the work ten times faster than can be done by hand, has been patented by the manufacturers (says the *Canadian Manufacturer*), Messrs. Connell & Dengler, of Rochester, N. Y. It has the advantage of printing in a very rapid and clear manner all cards or trade-marks much more perfectly than can be done by hand, thereby rendering it of great importance to the merchant or manufacturer. The type or form is cast in brass, and secured in such a manner that it can be easily and rapidly adjusted to print upon the board at the proper time. The inking rollers can be instantly raised from the type to prevent inking when the machine is not fed with boards. It will print boards varying from ¼ inch to 1¼ inches in thickness, and at the rate of 1,500 to 2,000 impressions per hour. The boards or sides of boxes are introduced to the machine in quantities of 10 to 20 pieces at a time, and the bottom piece of the pile is fed by a reciprocating bar to its proper place in order to receive the impression at the proper time, the boards above dropping down to be fed in like manner until all are printed.

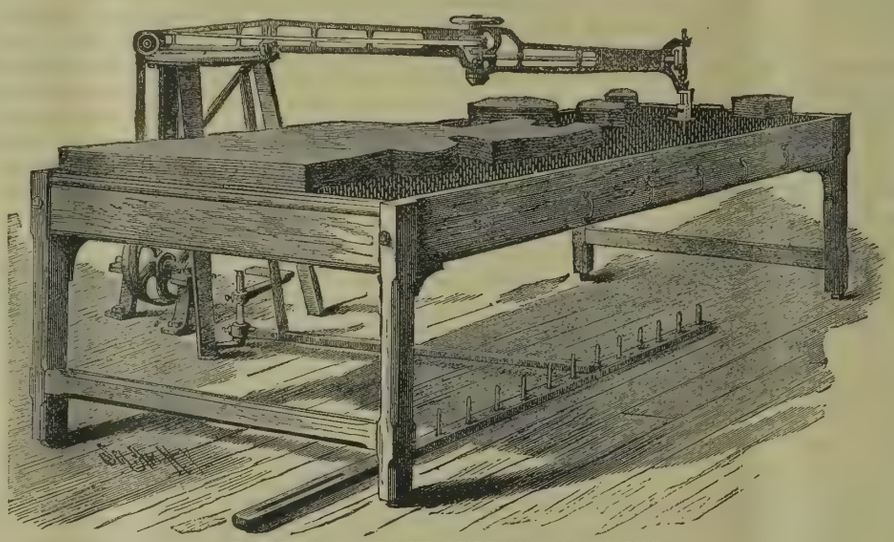
Fowler's Cloth-Cutting Machine.

In connection with the accompanying illustration of a very practical and useful machine, we publish below the report of a committee of experts appointed to examine into and pass judgment upon its merits. The report speaks very favorably of the machine:

Report of the Committee on Science and the Arts on the Fowler Cloth-Cutting Machine.

HALL OF THE FRANKLIN INSTITUTE,
PHILADELPHIA, April 3, 1882.

The sub-committee of the Committee on Science and the Arts, constituted by the Franklin Institute of the State of Pennsylvania, to whom was referred for examination Wm. R. Fowler's cloth-cutting machine, report that (at a meeting held on Monday evening, March 27, 1882, at the Institute, at which a majority of the members of the committee were present) they carefully examined a working model of the Fowler machine, and find that the following claims are worthy of merit, *e. g.:*



FOWLER'S CLOTH-CUTTING MACHINE.

The "cutters," or, more properly, the cutting knives, both the single and double. The cutting bed. The work-holding device.

1st. The cutters are made either single or double, having a single cutting edge, or several of these edges, so sharpened as to cut only upon the up-stroke, having the portion below the laid edge reduced in width, or tapered, so as to present a narrow tongue at or near the lower end of the blade, thus forming a strong, durable cutter; the blunt lower end projects beyond the cutting edge, thus protecting it. The series of projections or sharpened edges of the double knife recede from the lower to the upper portion of the knife in step-like form. The knives when working make 1,500 strokes per minute, and are made long enough to cut through 4 inches of cloth, and perform their work well. The knives can be easily ground.

2d. The cutting board consists of steel wires of sufficient length, set into "blocks" at regular intervals apart, and secured to a backing; the upper ends of the wires are rounded off. The regular spaces between the wires permit the traversing of the knife in accordance with any pattern marked upon the cloth. From the elasticity of the wires the knife cannot catch upon them, the blunt edge of the knife coming in contact with the wire, slips to one side by bending the wire slightly out of normal position. This sectional bed is inclosed in a rectangular frame resting upon four or more legs, to which are attached rollers; this arrangement permits the work-table to be drawn towards the operator when the arm of the machine is fully extended.

The work-holding device, in connection with the knife guide and abutment plate of skeleton form, are placed above upon the work, the knife guide in the general class of cloth cutters being placed underneath the work. This arrangement *above* is a new feature in this class of machines, and the advantages are apparent.

The general arrangement of the working parts of the machine is excellent. The idea of making it light in weight, but strong, is well carried out, the balancing of the arm good, the various parts are nicely fitted, and the machine works easily and performs its work very well indeed.

In furtherance of the above, your committee state that they recommend the award of a Diploma of Merit to Mr. Wm. R. Fowler for his cloth-cutting machine, for ingenuity in design and originality.

Pins.

The pins used in this country are made by fourteen factories, chiefly located in New England. The annual production for several years past has been about 7,000,000 pins. This number has not varied much for some years, the demand remaining about the same. Two years ago the competition among the nine principal companies then existing for the manufacture of toilet pins led to such a cutting of prices that the business became unprofitable, and the market was flooded with goods. A year ago a combination was formed of three wire companies, and now all the pins made by them are shipped to New York, and handled by the head agency of that city. From their common warehouse they are sent to every part of the country. The importations of English pins are small, and the exportations of pins from the United States is confined to Cuba, South America and parts of Canada. England supplies almost the whole world outside of the United States, although the American pins are not inferior in quality. The raw material—the brass and iron wire from which all American pins are made—is from the wire mills of this country, and much of the machinery is of American invention and patent.

Large Belts.

The largest belt ever made from a single width of hide has recently been made by P. Jewell & Sons, of Hartford, Conn., for a New York flouring mill. It is 48 inches wide, 96 feet long, and weighs 1,000 pounds.

The Jewells are about to surpass even this, and are now making two larger belts than the above, for one of the largest rubber factories in the country. One is 48 inches wide and 120 feet long; the other is 44 inches wide and 150 feet long, both double thickness. These are the largest belts that can be made from a single hide, as no hide can be solid and thick more than 4 feet in width. It is but a few years since belts of these proportions could be made, or pulleys on which to run them, and in no country but this is it done now.

ZINC.—The total production of zinc in Europe in 1880 amounted to 203,330 tons, of which Germany produced 99,405 tons, or nearly half, two-thirds coming from the Upper Silesian districts. After Germany came Belgium, with 65,010 tons, then England with 22,000 tons; France with 13.715, and Austro Hungary with 3,200 tons.

Market Report of Building Materials.

NEW YORK PRICES.

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LUMBER.

Pine, very choice and extra dry, ₱ M	$65 00 @ 75 00
Pine, good	55 00 @ 60 00
Pine, shipping box	21 00 @ 22 50
Pine, common box	18 00 @ 20 00
Pine, common box ⅝	16 00 @ 18 00
Pine, tally plank, 1¼, 10 inch, dressed each	— 44 @ — 50
Pine, tally plank, 1¼, 2d quality	— 35 @ — 38
Pine, tally plank, 1¼, culls	— 28 @ — 30
Pine, tally boards, dressed, good	— 30 @ — 32
Pine, tally boards, dressed, common	— 25 @ — 28
Pine, tally boards, culls, dressed	— 23 @ — 25
Pine, strip boards, merchantable	— 18 @ — 20
Pine, strip boards, clear	— 24 @ — 26
Pine, strip plank, dressed, clear	— 33 @ — 35
Spruce boards, dressed	— 25 @ — 26
Spruce plank, 1¼ inch, dressed	— 28 @ — 30
Spruce plank, 2 inch	— 43 @ — 45
Spruce wall strips	— 15 @ — 16
Spruce timber, ₱ M	19 00 @ 21 00
Hemlock boards, ₱ M	17 00 @ 18 00
Hemlock joist, 2½x4, each	— 16 @ — 17
Hemlock joist, 3x4	— 18 @ — 20
Hemlock joist, 4x6	— 40 @ — 44
Ash, good, ₱ M	55 00 @ — —
Oak	60 00 @ 65 00
Maple culls	25 00 @ 30 00
Maple good	45 00 @ 50 00
Chestnut	48 00 @ 52 00
Cypress, 1, 1½, 2, and 2½-inch	35 00 @ 40 00
Black Walnut, good to choice	120 00 @140 00
Black walnut, ⅝-inch	85 00 @100 00
Black walnut, selected, and seasoned	150 00 @175 00
Black walnut, counters, ₱ ft	— 22 @ — 28
Black walnut, 5x5	150 00 @160 08
Black walnut, 6x6	160 00 @170 00
Black walnut, 7x7	175 00 @180 00
Black walnut, 8x8	175 00 @180 00
Cherry, wide, ₱ M	100 00 @120 00
Cherry, ordinary	60 00 @ 80 00
White wood, inch	45 00 @ 50 00
White wood, ⅝-inch	35 00 @ 40 00
White wood, ⅝ panels	42 00 @ 45 00
Shingles, extra sawed pine, 18-inch	4 50 @ 5 50
Shingles, clear sawed pine, 16-inch	4 00 @ 4 50
Shingles, cypress, 24x6	18 00 @ 20 00
Shingles, cypress, 20x6	11 00 @ 12 00
Lath, Cargo rate	2 05 @ — —
Yellow dressed pine flooring	30 00 @ 40 00
Yellow pine girders	32 50 @ 40 00
Locust posts, 8 feet, ₱ inch	— 18 @ — 20
Locust posts, 10 feet	— 24 @ — 25
Locust posts, 12 feet	— 29 @ — 34
Chestnut posts, ₱ ft	— 3 @ —3½
Basswood ₱ M	25 00 @ 30 00

Cargo rates 10 ₱ cent off.

CEMENT—PER BARREL.

Portland (imported)	2 65 @ 2 85
Portland (American)	2 30 @ 2 75
Portland (Lafarge)	3 60 @ 3 75
Lime of Teil	2 30 @ 2 50
Lime of Teil, ₱ ton	15 00 @ 18 00
Roman	3 00 @ 3 25
Keene's & Martin's, coarse	9 50 @ 10 00
" fine	12 00 @ 13 00
Rosendale	1 10 @ 1 15

SOLDERS.

Half and half	16½ @ — 16¾
Extra	15½ @ — 15¾
No. 1	14 @ — 14¼

ZINC.—Duty, sheet, ₱ lb, 2½ cents.

Sheet (cask) ₱ lb	7 @ — 7¼
Sheet (open)	7½ @ — 8

BRICKS.

	Cargo.	Afloat.
Pale, ₱ M	3 00 @	4 00
Up Rivers	5 75 @	6 25
Jersey	5 50 @	6 00
Haverstraw Bay	6 50 @	6 75
" " choice	7 00 @	7 12½
Favorite Brands	7 25 @	— —
Hollow Fire-Clay Brick	9 00 @	9 25

FRONTS.

Croton—Brown, ₱ M	11 00 @ 12 00
" Dark	13 00 @ 14 00
" Red	13 00 @ 14 00
Philadelphia, on pier	30 00 @ — —
Trenton "	30 00 @ — —
Baltimore "	38 00 @ 40 00
Clark's Glens Falls, White	30 00 @ — —
" " Red Fronts	27 50 @ — —
" " Molded Red and White	45 00 @ 80 00

Yard prices 50 cents ₱ M higher, or with delivery added $2 ₱ M for hard and $3 ₱ M for front brick. For delivery add $5 on Philadelphia, Trenton and Glens Falls and $6 on Baltimore brick.

STONE.—Cargo Rates Delivered in New York.

Amherst Freestone, No. 1, in rough, ₱ c. f	1 00 @ — —
do do No. 2	— 85 @ — 95
Bedford Stone	1 25 @ — —
Berlin Freestone, in rough	— 75 @ 1 00
Berea Freestone, in rough	— 75 @ 1 00
Brown Stone, Portland, Conn	1 00 @ 1 35
Bay of Fundy Wood Point Brown Stone	1 00 @ — —
do Mary Point Brown Stone	1 00 @ — —
do do Olive Stone	1 00 @ — —
Brown Stone, Belleville, N. J	1 00 @ 1 35
Granite, rough	— 60 @ 1 25
Canaan Marble	1 25 @ 1 50
Sutherland Falls Marble	1 25 @ 1 75
Dorchester, N. B., Stone, rough, ₱ foot	1 00 @ — —

LEAD—PER 100 POUNDS.

German	— — @ — —
English, common	— — @ — —
Spanish	5 75 @ — —
Foreign, refined	— — @ — —
Bar	6 50 @ — —
Sheet	7 50 @ — —
Pipe	— — @ — —
Domestic	4 63 @ — —

SLATE.

Purple, roofing slate, ₱ square	$7 00 @ 8 00
Green Slate	7 00 @ 8 00
Red Slate	15 00 @ — —
Black Slate, Pennsylvania, (at Jersey City)	4 75 @ 5 25
Slate tiles, 1¼-inch, rubbed, ₱ square foot	— 20 @ — 25

TIN PLATES.—Duty, 1 1/10 cents ₱ lb.

I. C. charcoal, 10x14, ₱ box	6 25 @ 6 50
I. C. coke, 10x14	5 25 @ 5 75
I. X. charcoal, 10x14	8 25 @ 8 37½
I. C. charcoal, 14x20	6 25 @ 6 50
I. X. charcoal, 14x20	8 25 @ 8 37½
I. C. coke, 14x20	5 25 @ 5 75
I. C. coke, terne, 14x20	5 25 @ 5 37½
I. C. charcoal, terne, 14x20	5 50 @ 5 75

NAILS—PER KEG.

10d to 60d, common, fence and sheathing	3 30 @ 3 40
8d and 9d, common	3 65 @ — —
6d and 7d, common	3 90 @ — —
4d and 5d, common	4 15 @ — —
3d and 4d, light	4 95 @ — —
3d, fine	5 65 @ — —
2d, fine	5 65 @ — —
Cut spikes, all sizes	3 65 @ — —
Clinch nails, 1⅛ to 1¾ inch	5 65 @ — —
do. 2 to 2½ inch	5 40 @ — —
do. 2½ to 2¾ inch	5 15 @ — —
do. 3 inch and longer	4 90 @ — —

IRON—PER TON.

Duty.—Bar, 1 to 1½c. ₱ lb. ; Railroad, 70c. ₱ 100 lb. ; Boiler and Plate, 1½c. ₱ lb. ; Sheet, Band, Hoop, and Scroll, 1¼ to 1¾c. ₱ lb. ; Pig, $7 ₱ ton ; Polished Sheet, 3c. ₱ lb. Galvanized, 2½c. ₱ lb. ; Scrap cast, $6 ₱ ton ; Scrap Wrought, $6 ₱ ton—all less 10 ₱ cent. No Bar Iron to pay a less duty than 35 ₱ cent ad val.

Pig, Scotch—Coltness	27 00 @ 27 50
" Glengarnock	24 50 @ 25 00
" Eglinton	23 00 @ 23 50
" American, No. 1	26 50 @ 28 00
" American, No. 2	24 00 @ 25 00
" American forge	22 00 @ 23 50

PAINTS.

Carmine, American, ₱ lb	5 00 @ 5 25
Chalk, ₱ 100 lbs	— 35 @ — —
China Clay, ₱ ton	18 00 @ 20 00
Chrome yellow, dry, ₱ lb	— 12½ @ — 28
Lead, red American, ₱ lb	— 6¾ @ — 7
Lead, white American, pure, in oil	— 7½ @ — 8
Lead, white American, pure, dry	— 6¾ @ — 7
Lead, white English, pure, in oil	— 9 @ — 10
Litharge	— 6¾ @ — 7
Ocher, Fr., dry, ₱ 100 lbs	1 50 @ — —
Ocher, ground, in oil, ₱ lb	— 6 @ — 15
Ocher, Vermont, ₱ 100 lbs	— 75 @ 1 00
Orange Mineral, English	— 9 @ — 10
Paris White, American	— 1½ @ — 1¾
Paris White, English, prime	— 2 @ — 2¼
Paris Green	— 15 @ — 28
Plumbago paint, patent, ₱ lb	— — @ — 25
Putty, ₱ lb	— 2 @ — 2½
Spanish Brown, dry, ₱ lb	— 1⅛ @ — 1¼
Spanish Brown, ground in oil, ₱ lb	— 8 @ — 9
Venetian red, ₱ cwt	1 75 @ 2 00
Vermilion, Chinese, ₱ lb	— 85 @ — 90
Vermilion, Trieste	— 70 @ — 75
Vermilion, quicksilver, bags	— 50 @ — 52½
Vermilion, American, common	— 15 @ — 18
Whiting, ₱ 100 lbs	— 60 @ — 80
Zinc, white American, dry, No. 1	— 5 @ — 7½
Zinc, white American, No. 1, in oil	— 8 @ — 10
Zinc, white French, dry, (Red Seal,)	— 7 @ — 8
Zinc, white French, in oil	— 10 @ — 10½

VARNISHES—PER GALLON.

American Wearing Body	3 50 @ 4 00
Coach Body	2 35 @ 3 50
" "	1 80 @ 2 00
Furniture	1 25 @ 2 50
Black Asphaltum	1 00 @ 1 50
Brown Japan	1 00 @ 1 20
Liquid Paint Dryer	1 35 @ 1 75
Harness, (black)	3 00 @ 4 50
Shellac, Spirits	3 00 @ 3 50

LIME—PER BARREL.

State, common	1 00 @ — —
" finishing	1 20 @ — —
Rockland, common cargo rate	1 10 @ — —
" finishing	1 20 @ — —
Ground	— 90 @ 1 00

Add 25 cents to above figures for yard rates.

HAIR.

Cattle, ₱ bushel of 7 lbs	— 18 @ — 21
Goat " "	— 30 @ — 35

PLASTER PARIS.

Duty.—20 ₱ cent ad. val. on calcined ; lump free.

Calcined, ordinary city, ₱ bbl	1 30 @ 1 35
Calcined, city casting	1 50 @ 1 65
Calcined, city superfine	1 70 @ 1 75

MAHOGANY.

St. Domingo, crotches, ordinary to good, ₱ ft	— 15 @ —20
St. Domingo, crotches, fine	— 20 @ —30
St. Domingo, logs, small	— 5 @ — 8
St. Domingo, logs, large	— 8½@ —14
Frontera, Mexican, large	— 12 @ —15
Frontera, Mexican, small	— 6 @ — 8
Other Mexican	— 9 @ —11
Honduras	— 6 @ —12½
Rosewood, ordinary to good, ₱ lb	— 2½ @ — 4½
" good to fine	— 5 @ — 8
Satin Wood, ₱ foot	— 15 @ — 75
Tulipwood, ₱ lb	— 6 @ — 7
Lignumvitæ, large, ₱ ton	30 00 @ 50 00
Lignumvitæ, other sizes	10 00 @ 25 00

CEDAR.

Cuba and Mexican, small, ₱ super. ft	6 @ — 7½
Cuba and Mexican, medium	8 @ — 9½
Cuba and Mexican, large	10 @ —11
Florida, ₱ cubic foot	40 @ —75

DEADENING AND ROOFING MATERIAL.

Mineral wood for Roofs and deadening, ₱ lb	— 1¼ @ —1½

LABOR.

Ordinary, ₱ day	2 00 @ 2 50
Masons, do	3 50 @ 4 00
Plasterers, do	4 00 @ — —
Carpenters, do	4 00 @ — —
Plumbers, do	4 00 @ 4 50
Painters, do	3 00 @ 3 50
Stone-Cutters, do	3 00 @ 3 50

REVIEW OF THE MARKETS.—In the lumber market the past month business has been somewhat unsatisfactory. Former values have apparently been supported without much difficulty, and indeed made a fractional gain occasionally; here and there a dealer has been found quite active on home orders, where certain favorable conditions gave an advantage over competitors, and the export trade has been picking up; yet there has been a noticeable absence of vim and volume to trade, and complaints have been numerous. The season of the year, however, is a good point in sellers' favor, and the general inclination appears to be to carry desirable supplies against the time when arrivals may naturally be expected to fall off, and accumulated stocks stand better chance for attention.

In the brick market common hards have experienced quite a boom, and, with the advance made, sellers have naturally felt cheerful. The basis of improvement is, in brief, an excess of demand over supply, and no indication of any immediate relief, as there is a sufficient number of back orders unfilled to balance a considerable addition to the offering, should such occur.

In the cement market well-known, first-class brands have been maintained in price, and have sold close enough to the offering to prevent an accumulation in first hands, even with the recent full arrivals; while irregular stock, though finding a fair trade, has been a less certain article to handle, and has varied materially in price.

In the lime market the demand has continued to about sustain its former volume, and prices, without actual advance, have been pretty firm. Receivers have been making no additions to the offerings, in view of the absence of production, and it is expected this influence must eventually act as a stimulus to the market.

In the lath market business has developed the elasticity so noticeable this season, and has shown a very fair recovery. The large amounts previously distributed, very naturally have had a tendency to give many buyers a sufficient supply, for the present at least, and has made the demand less general, but nothing has been offered that did not receive prompt attention, and the price has gone up again to $2.15 on actual sales, with renewed bids at this figure refused on cargoes here or close at hand.

In the hardware market dealers have been doing a very fair export trade on all the regular outlets, and the local business has also been good, the latter, indeed, rather tending to increase if anything, especially in the way of builders' hardware. The interior demand, however, may still be recorded as disappointing, and in some cases there has been an unexpected falling off. The more conservative dealers, however, are by no means discouraged, but, on the contrary, rather look upon matters with a hopeful feeling.

In the nail market business has retained a brisk tone and exhausted the supply about as fast as it was offered, the regular sizes in particular disappearing quickly.

In the metal markets Scotch pig has secured a fair amount of attention, and the market generally has been satisfactory to the selling interest. From accumulated stocks the offerings have been moderate, but average amounts can be reached "to arrive." Values have been steady. American pig met with no unusual demand, but still has gone out into consumption with a very steady movement, fast enough, in fact, to prevent any important accumulation from the current production of either the high or low grades. Manufactured iron has been selling to about the average extent, and most of the exports made would indicate a well sustained market for all standard sizes. Domestic pig lead has been selling to a pretty full extent at times, and the position has retained much general strength, with an advancing tendency if anything. Tin in pig arrived to some extent, but this did not appear to increase the available supply, and holders remained firm and confident. Tin plates have remained quite steady on all standard sizes, with the movement into consumption fair, and first-hand stocks of only moderate proportions.

The Range Boiler.

Serious and insurmountable obstacles inherent in the present system of range boiler circulation have presented themselves from the date of its introduction:

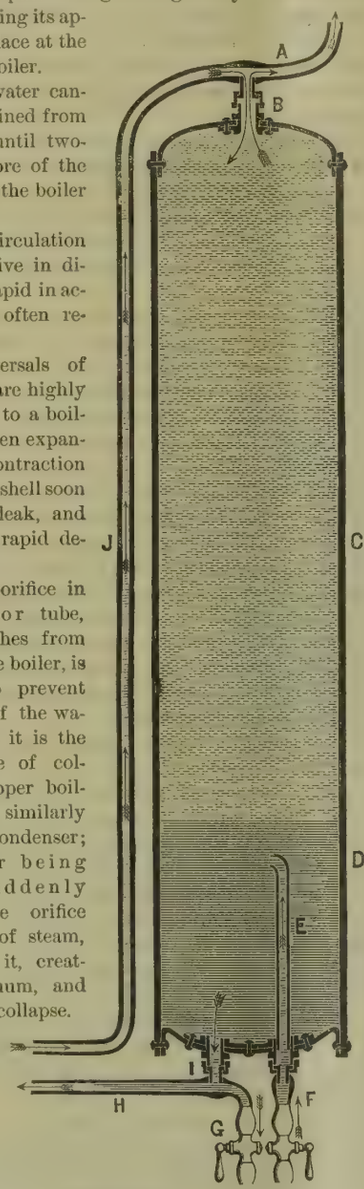
1st. The heated water, after entering the boiler, is obliged to pass through a large body of cold water before reaching its appropriate place at the top of the boiler.

2d. Hot water cannot be obtained from the boiler until two-thirds or more of the contents of the boiler is heated.

3d. The circulation is not positive in direction or rapid in action, as it often reverses.

4th. Reversals of circulation are highly detrimental to a boiler; the sudden expansion and contraction of the boiler shell soon cause it to leak, and tend to its rapid destruction.

5th. The orifice in the interior tube, about 4 inches from the top of the boiler, is intended to prevent siphonage of the water, whereas it is the prime cause of collapse in copper boilers, acting similarly to a jet condenser; cold water being forced suddenly through the orifice into a body of steam, condensing it, creating a vacuum, and consequent collapse.



Boiler No. 1.

Creque's patented new circulation range boilers, manufactured by Messrs. Creque, Ronalds & Co., of New York, obviate these difficulties. The principles involved in their new system are extremely simple, as may be observed in the accompanying diagrams. Cold water is supplied at the bottom of the boiler, while hot water is injected into the top of the boiler. This system of circulation has never reversed its action. The hot water delivery pipe being connected with the distributing pipe, hot water can be drawn as soon as the water-back is hot. The hottest water will be always the first to be drawn, whether it is from the boiler or the water-back. The following are some of the advantages claimed:

1st. Delivery of cold water at the *bottom* of the boiler without chilling the heated water at the top of the boiler.

2d. Hot water is injected directly into the boiler at the *top*, the proper place for its accumulation, instead of at the side near the bottom of the boiler, thus avoiding the chilling of the hot water in its passage to the top of the boiler.

3d. Hot water being stored at the top of the boiler without chilling, it can be used immediately, thus making the boiler serviceable as soon as the water-back is heated. Parents will readily see the advantage of this in the case of a sick child or adult requiring a hot bath at night after the range fire has been extinguished.

4th. The circulation is positive in direction and rapid in action, and heats in very much less time.

5th. Circulation being positive, there is no cracking, snapping or rumbling in the boiler.

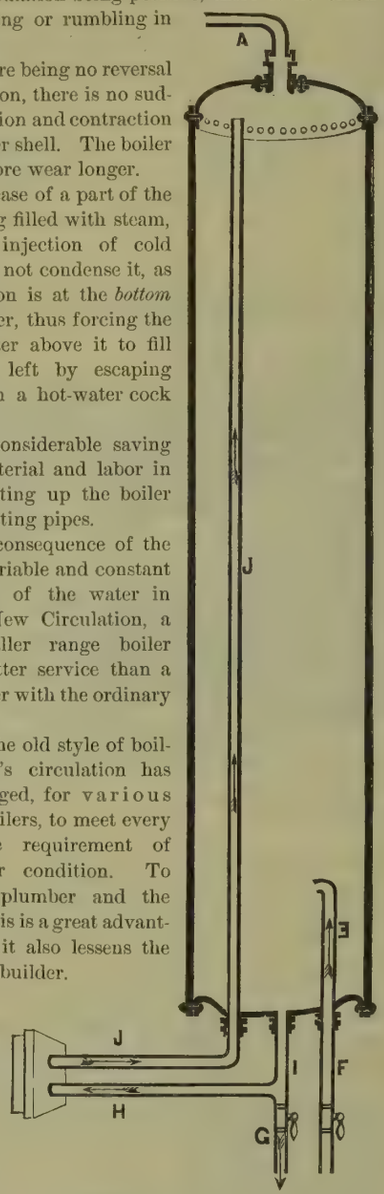
6th. There being no reversal of circulation, there is no sudden expansion and contraction of the boiler shell. The boiler will therefore wear longer.

7th. In case of a part of the boiler being filled with steam, a sudden injection of cold water does not condense it, as the injection is at the *bottom* of the boiler, thus forcing the heated water above it to fill the space left by escaping steam when a hot-water cock is opened.

8th. A considerable saving both in material and labor in cost of setting up the boiler and connecting pipes.

9th. In consequence of the rapid, invariable and constant circulation of the water in Creque's New Circulation, a much smaller range boiler will do better service than a larger boiler with the ordinary method.

Unlike the old style of boiler, Creque's circulation has been arranged, for various styles of boilers, to meet every conceivable requirement of location or condition. To both the plumber and the architect this is a great advantage, while it also lessens the cost to the builder.



Boiler No. 2.

These boilers have been in constant use for the past year, and have fully demonstrated all that is claimed for them.

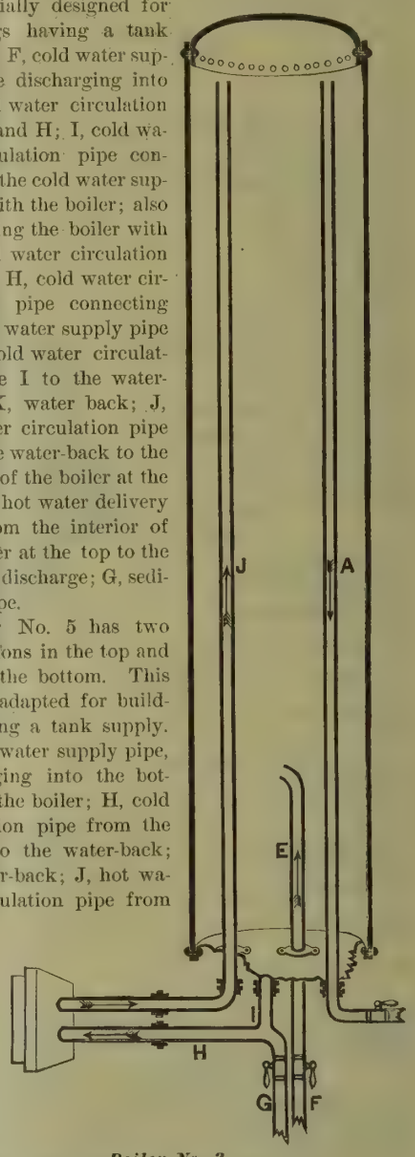
Boiler No. 1 has only three connections, two located at the bottom and one in the top. F, cold water supply pipe; E, interior tube for the prevention of siphonage; H, cold water circulation pipe from the bottom of the boiler to the water-back; K, water-back; J, hot water circulation pipe from the water-back to the top of the boiler; B, tee connection device for the injection of hot water into the boiler, and the discharge of hot water from the boiler into the hot water delivery pipe A; A, hot water delivery pipe; G, sediment pipe.

Boiler No. 2 has three connections in the bottom and one at the top. F, cold water supply pipe; E, interior tube for the prevention of siphonage; H, cold water circulation pipe from the boiler to the water-back; K, water-back; J, hot water circulation pipe from the water-back to the interior of the boiler at the top; A, hot water delivery pipe; G, sediment pipe.

Boiler No. 3 has four connections, all located at the bottom. F, cold water supply pipe; E, interior tube for the prevention of siphonage; H, cold water circulation pipe from the bottom of the boiler to the water-back; K, water-back; J, hot water circulation pipe from the water-back to the interior of the boiler at the top; A, hot water delivery pipe from the interior of the boiler at the top to the discharge orifice; G, sediment pipe.

Boiler No. 4 has three connections, all located in the bottom. This style is especially designed for buildings having a tank supply. F, cold water supply pipe discharging into the cold water circulation pipes I and H; I, cold water circulation pipe connecting the cold water supply F with the boiler; also connecting the boiler with the cold water circulation pipe H; H, cold water circulation pipe connecting the cold water supply pipe F and cold water circulating pipe I to the water-back; K, water back; J, hot water circulation pipe from the water-back to the interior of the boiler at the top; A, hot water delivery pipe from the interior of the boiler at the top to the point of discharge; G, sediment pipe.

Boiler No. 5 has two connections in the top and two at the bottom. This style is adapted for buildings using a tank supply. F, cold water supply pipe, discharging into the bottom of the boiler; H, cold circulation pipe from the boiler to the water-back; K, water-back; J, hot water circulation pipe from the water-back to the interior of the boiler at the top; A, hot water delivery pipe; G, sediment pipe.



Boiler No. 3.

Scarcity of Ivory.

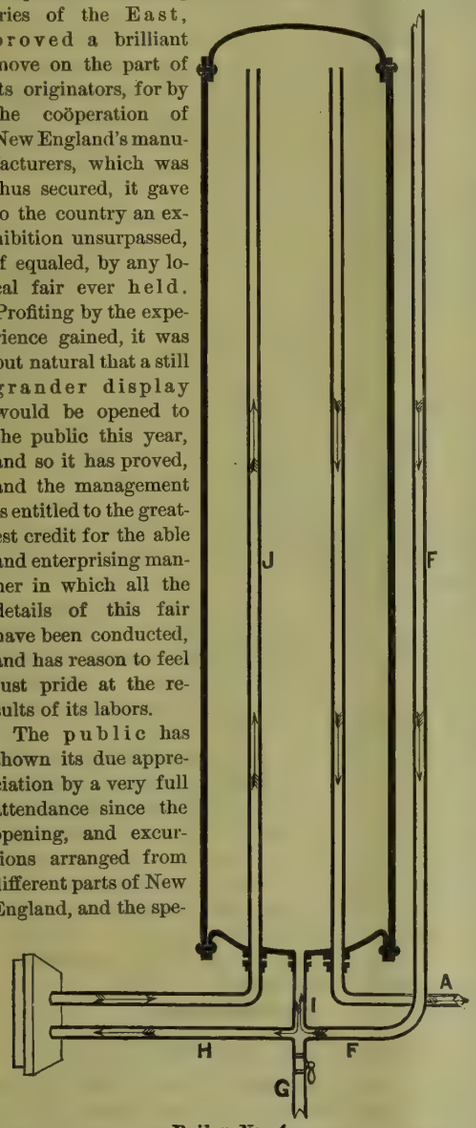
It is stated in the *Engineer*, that on May 15th there were only 127½ tons of ivory in stock in London. The smallest stock for many years was in March last, namely, 107½ tons; the largest in July, 1878, viz., 301¼ tons. At present there are probably in dealers' private warehouses about 40 tons, while at one time the private dealers used to hold over 100 tons in their own warehouses. Eight ivory cutters in Sheffield cut up $620,000 worth of tusks in a year, and the two largest cutlery houses add a value of $80,000 each per annum to that total. One-fourth of all the ivory imported into England is used in Sheffield for

cutlery hafting, and other purposes. It does not appear that any really satisfactory substitute for ivory has yet been produced. The material known under various names, but generally called celluloid, has not served more than a limited purpose. The same may be said of vegetable ivory. None of these things will take the peculiar polish of ivory. An enormous trade could be done in a really satisfactory substitute for elephants' tusks.

New England Manufacturers' and Mechanics' Institute Fair.

The inauguration of the New England Manufacturers' and Mechanics' Institute last year, for the purpose of exhibiting the rich manufacturing industries of the East, proved a brilliant move on the part of its originators, for by the coöperation of New England's manufacturers, which was thus secured, it gave to the country an exhibition unsurpassed, if equaled, by any local fair ever held. Profiting by the experience gained, it was but natural that a still grander display would be opened to the public this year, and so it has proved, and the management is entitled to the greatest credit for the able and enterprising manner in which all the details of this fair have been conducted, and has reason to feel just pride at the results of its labors.

The public has shown its due appreciation by a very full attendance since the opening, and excursions arranged from different parts of New England, and the special attractions offered, have tended to bring people from all sections.



Boiler No. 4.

There is so much to be seen in the various departments, that the visitor who goes with the expectation of spending an hour, will generally spend two. But a few hours will not suffice to gain a comprehensive idea of the contents. There is so much to be seen, that one may wander through the aisles for a day and yet find something of interest at every turn. The visitor should be prepared to give the better part of the day to the fair, or, what is better still, he should attend several times during its progress, for in this way he can see the most with the least exertion.

On entering the building, there is a large area of floor space elevated above the level of the main building, and filled with an attractive class of exhibits. At the extreme left of this portion of the building is situated the restaurant, and nearer the entrance the press and superintendent's offices, check room for clothing and packages, and a telephone office. On the main floor is the machinery department, in which the display is large and extensive.

Confining ourselves in this article principally to this department, we first note the fine display of steam engines. There are no less than twelve in operation in the building. These are the Porter-Allen, the Kendall & Roberts, the Swamscot, the Hartford High-Speed, made by the Hartford Engineering Co., of Hartford; two of the Armington & Sims; three of the Hawkins; the Westinghouse, manfactured by the Westinghouse Machine Co., of 92 and 94 Liberty street, New York; and the Exeter, manufactured by the Exeter Machine Works, of Exeter, N. H. This engine is in operation running the textile machinery of the Lowell Machine Shop, Howard & Bullough & Riley, and L. J. Knowles & Brother. This is of 50 horse-power, with 13×30 cylinder. Another Exeter engine of 25 horse-power, with 10×24 cylinder, and one of 18 horse-power, with 8×18 cylinder, are exhibited; there are also exhibited by this company fan blowers, pressure blowers, and exhaust fans. The space occupied by this display measures about 35×40 feet.

The Massachusetts Institute of Technology exhibits a finely mounted set of specimens of seed-cotton, patterns and drawings, architectural drawings, a small steam engine neatly built by M. P. Barnard after taking the course in shop work, and specimens of work in wood and metal, neatly done by the students.

The Hancock inspirator is shown by the Hancock Inspirator Co., of Boston. Every steam user is interested in the exhibit of this well-known apparatus, which is placed very appropriately near the engines on the left-hand side of the building. Here are three machines on a 6-foot lift and one on a 24-foot 10-inch lift, running with 70 pounds feed against 80 pounds. Locomotive and stationary inspirators and ejectors for lifting water, tan liquor or other chemicals, are very attractively displayed against a background of maroon felting. Here also is the award received by the Hancock inspirator at Atlanta, for the best boiler feeder exhibited.

The Chase Turbine Manufacturing Co., of Orange, Mass., display their saw mill, edging machine, and turbine water-wheel.

The Rollstone Machine Co., of Fitchburg, Mass., show their band saw, pony planer, wood-turning lathe, surfacing machine, and edger—all for wood.

The S. A. Woods Manufacturing Co., of New York, Boston and Chicago, have the finest display of wood-working machinery in the fair. The exhibit embraces their surface planer, pony planer, edging machine, saw arbors, upright boring machine, and other wood-working tools.

The Union Stone Co., of 38 Hawley street, Boston, New York, Philadelphia and Cincinnati, exhibit emery wheel grinders for a variety of purposes, and of sizes; also emery wheels, machines for polishing metal, crocus wheels, emery cloth, sand paper, Turkish emery, and a variety of materials and wheels for fine polishing.

The Curtis Regulator Co., of 54 Beverly street, Boston, exhibit a Curtis regulator for steam, air or water.

B. F. Sturtevant, of Boston, has a magnificent display of fan and pressure blowers, exhaust fans, etc.

The new pulsometer made by the Pulsometer Steam Pump Co, of 83 John street, this city, is exhibited by S. B. Everett & Son, of 32 Charlestown street, Boston, in two sizes in operation.

E. E. Garvin & Co.'s machinists' tools are exhibited by W. A. Davis, of Boston.

The Tewksbury Automatic Elevator Co., of 60 Temple court, New York, exhibit the Tewksbury automatic elevator for packages and light freight.

H. R. Worthington, of New York and Boston, exhibits the Worthington duplex steam pump.

The Deane Steam Pump Works, of Holyoke, Mass., and this city, have a handsome display of their pumps.

Otis Brothers & Co., 346 of Broadway, New York, have a hydraulic elevator in operation.

The Miller's Falls Co., of 74 Chambers street, New York, exhibit levels, drill stocks, carving tools, braces, etc.

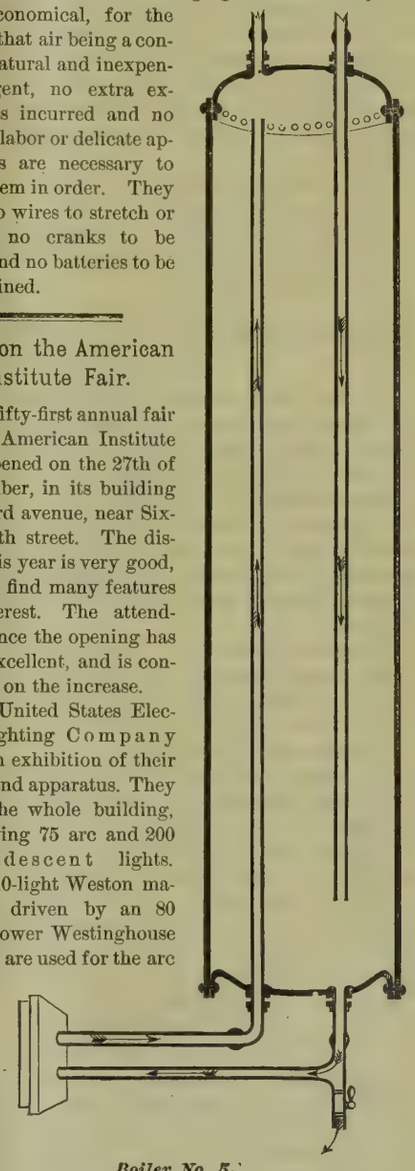
The New England Press Brick Co., of 39 B, Equitable building, Boston, exhibit Gregg's brick machine in operation.

Zimdar's patent pneumatic bells and annunciators, manufactured in this city, at 9 Laight street, J. Hunt, managing partner, are exhibited by J. G. Marston & Co., Boston agents. These annunciators are very simple in principle and construction, air in its normal condition (conveyed by lead tubes ⅛ inch in diameter) being the only motive power used, which is compressed in the act of ringing the bell. They are very economical, for the reason that air being a constant natural and inexpensive agent, no extra expense is incurred and no skilled labor or delicate appliances are necessary to keep them in order. They have no wires to stretch or break, no cranks to be reset, and no batteries to be maintained.

Notes on the American Institute Fair.

The fifty-first annual fair of the American Institute was opened on the 27th of September, in its building on Third avenue, near Sixty-fourth street. The display this year is very good, and we find many features of interest. The attendance since the opening has been excellent, and is constantly on the increase.

The United States Electric Lighting Company have an exhibition of their lights and apparatus. They light the whole building, employing 75 arc and 200 incandescent lights. Eight 10-light Weston machines, driven by an 80 horse-power Westinghouse engine, are used for the arc lights, and two 100 light dynamos, each driven by an 18 horse-power Westinghouse engine, for the incandescent, which are of the Maxim type. The Westinghouse engine is manufactured by the Westinghouse Machine Co., of 92 and 94 Liberty street, this city.



Boiler No. 5.

The machinery department is very creditable, and there is a goodly representation of manufacturers here. The familiar thud of the drill boring through gneiss rock is heard above the sound of the electric light generators.

Artificial fuel, manufactured according to the process of E. F. Loiseau, of Philadelphia, is to be used, during the progress of the fair, for the purpose of generating the steam required to run the machinery.

About twenty-five of the blowers of B. F. Sturtevant, of 156–160 Oliver street, Boston, are shown.

E. E. Garvin & Co., of this city, have a fine display of machinists' tools on exhibition.

C. H. Delamater & Co., of this city, exhibit their well-known steam pump and the Ericsson coloric pumping engine.

The Hartford Engineering Co., of Hartford, Conn., show the Hartford automatic cut-off engine; also the Medart pulley.

S. J. Pardessus, of this city, displays his admirable glass dome ventilating skylights in various forms.

George Hayes, of this city, exhibits his skylights and ventilating apparatus.

The H. W. Johns Manufacturing Co., of this city, show their asbestos products, including their asbestos liquid paints, asbestos roofing, asbestos boiler coverings, and asbestos steam packing.

Zimdar's patent pneumatic bells and annunciators, manufactured at 9 Laight street, this city, are shown, and attract much attention. These annunciators are a vast improvement over other forms of these arrangements, dispensing as they do with batteries, and operating simply by the compression of air through ⅛-inch lead tubing.

A silk loom is in operation, and is full of interest to the throngs which surround it daily.

An incubator, by which the inventor claims to be able to hatch a brood of chickens every day, is one of the novelties of the fair.

Illustrated Catalogue of the J. L. Mott Iron Works.

The above named, well-known establishment has just issued a superbly executed catalogue of its manufactures, which, from its elaborate and costly character, and the excellent taste displayed in its execution, surpasses anything of the kind that we have yet seen. The engravings, representing the numerous articles manufactured by this house, are executed with great perfection of detail, and in the case of many of them, in colors, and give a very truthful idea of the articles themselves.

The title of the work is, "1882—Illustrated Catalogue; Artistic Grates, Fenders, Andirons, Fire Irons and other Goods, for the Fitting and Decoration of the Fire-Place. The J. L. Mott Iron Works, 88 and 90 Beekman street, New York."

The title page lettering is on a light yellow ground, which rests on a ground of grayish tint, the whole surrounded by a red border line. The prevailing colors of the body of the work are rich shades of gray and yellow (the latter intended to represent, as it does excellently, brass work). Many handsome borders adorn the letter-press, and the cuts are superbly executed. The catalogue contains no less than 175 plates. It is elegantly bound in olive cloth binding, stamped with gold in unique design.

Theiss' New Music Hall.

A commodious and elegant music hall was opened on East Fourteenth street, between Third and Fourth avenues, by George Theiss, on Thursday, September 7th. Mr. Arthur Crooks, the architect, has fairly outdone himself in the design of this establishment. He was given a difficult architectural problem to solve, to fit a place for its uses, and then he set about making it beautiful. The hall must be judged as a whole. Mr. Crooks designed and decided every bit of detail, selecting every color in tile decoration. The decoration is elaborate, and reflects the highest credit upon all the parties connected with it. The stained glass work by Kirkland is especially fine.

Miscellaneous and Advertising.

In the German army more and more attention is being paid to the science of aerostatics, and officers are being trained to make balloon ascensions.

The George Place Machinery Company, of 121 Chambers street, this city, have always on hand a large line of new and second-hand machinery of every description.

"How to Keep Boilers Clean," and other valuable information for steam users and engineers. Book published by James F. Hotchkiss, 84 John street, New York. Mailed free to any address. (Mention this paper.)

The Stilwell & Bierce Manufacturing Co., of Dayton, Ohio, report large and increasing sales of their specialties—Odell's roller mills, the Victor turbine, and Stilwell's lime extracting heater, all of them machines of very decided merit.

Houghton & Co., of 15 Hudson and 130 Reade streets, this city, recently made the largest shipment of their boiler compound for scale prevention that was ever exported. They shipped three tons of it to India, where they have worked up a large trade.

Mr. Hansen, an Austrian architect, lately discovered that the brilliancy of Pompeian mural painting is due to a stucco luster of whitening or chalk with the dust of marble, and has produced work exactly similar. Some of the decorations of the new Austrian Reichsrath are to be after this process.

The Curtis steam trap, manufactured by the Curtis Regulator Co., of 54 Beverly street, Boston, is taking the lead for efficiency in discharging water in large quantities. The Lancaster Mills, Clinton, Mass., and the Presumpscot Pulp Ware Co., Portland, Me., have recently ordered them in various sizes.

The Oneida Steam Engine and Foundry Co., of Oneida, N. Y., are now employing their full force in the manufacture of their lathe and drill chucks, and have recently fitted additional room to make a geared chuck, universal or independent. Their scroll combination chuck is made in sizes from 4 to 36 inches.

Yankee Notions.

The accompanying cut represents the latest novelty under this head—the Magic Water Gauge Reflector for steam boilers. We have received from the H. B. Smith Machine Co., of 925 Market street, Philadelphia, Pa., who are the sole proprietors, the following statement of its merits: It enables an engineer to see the hight of water in his gauge glass clearly, even in a comparatively dark room. In cases where boilers are placed in cellars and dark places, it will in a short time save its cost in burning gas. It is so arranged as to show a distinct line almost entirely across the reflector, thus rendering the water-line visible from across the engine-room, and materially lessening the danger of explosion from low water in the boiler.

Any one can have a sample reflector sent postpaid for $1.50. It is one of those precautionary devices which all careful engineers will have.

CORRESPONDENCE.

A Mechanic's Criticisms.

To the Editor of the Manufacturer and Builder:

In the Manufacturer and Builder for September, you publish an article headed "How may I Possess a Home?" and it is addressed to the working people. From the reading of it, it is a pretty hard matter to make out who the writer means by the working people; but since your journal is intended for mechanics, I take it for granted it means them.

Now, allow me, if you will, to criticise that article a little, for it is very evident that the writer of it knows but little about a mechanic's life, and I doubt very much if he is a mechanic earning his bread by his daily toil.

At almost the very commencement of his article, he says: "In most cases they do not choose to buy and pay for the houses in which they make their homes." If he will take the trouble to associate with mechanics, he will find that they are compelled in most cases to live in double tenement houses, and their entire earnings for ten years would not pay for them. It is certain that if they had the money (most of them), they would not buy a house of that kind for their families, as in most cases they are not fit places for an American man to bring up his family. He also says it is not because they cannot, but because they will not. Now, let us see if they can. Mechanics, as a rule, will not average, take it the year round, over $900; but, to do the writer justice, let us call it $3.25 per day. That would be a little more than $900. The earnings of most every mechanic have to support at least four persons—that is, himself, wife and children or mother, or some one generally depending on him.

Six days' work at $3.25 per day, is $19.50 for a week's wages. Now, allow for one week's rent $5, and you have $14.50 to be divided into seven days, or $2.07⅐, for twelve meals (that alone would only be about 17 cents a meal); for wood and coal, clothes, furniture, doctor's and undertaker's bills, lost time, etc., and a little spending money for four.

Now, will the writer be kind enough to tell us poor mechanics how to divide the above amount, and at the same time have something left to gratify an unreasonable appetite or a vitiated taste. The writer will oblige a number of mechanics if he will inform us through your October number where they can buy a home near enough to their work to enable them to reach it without traveling half the night, and where the amount required on installments and the fares will not amount to more than they pay for rent here, to say nothing about the excess of wages he talks about, and we will say "Our house," etc.

I, like many others, do not go pleasure riding, or to theaters and concerts (have not been in one for over ten years); $2.50 would be a very large amount for what I spend for tobacco in the course of a year. But I do not know what you mean by clothing not in harmony with a rented house. I do not believe the writer of that article would be willing to pay 50 cents a day more than the regular wages for the sake of having his work done by mechanics who live in their own honses.

Now, I must say, Mr. Editor, I felt very much hurt when I read that article, and I think it is due to the mechanics of our city that this letter should be published in your October number, together with a reply from the writer, or, shall I say, an apology. I must confess it is very cutting (the article referred to).

From one of the many who desire to improve their condition in life.

A. N. Y. Carpenter.

New York, September 18, 1882.

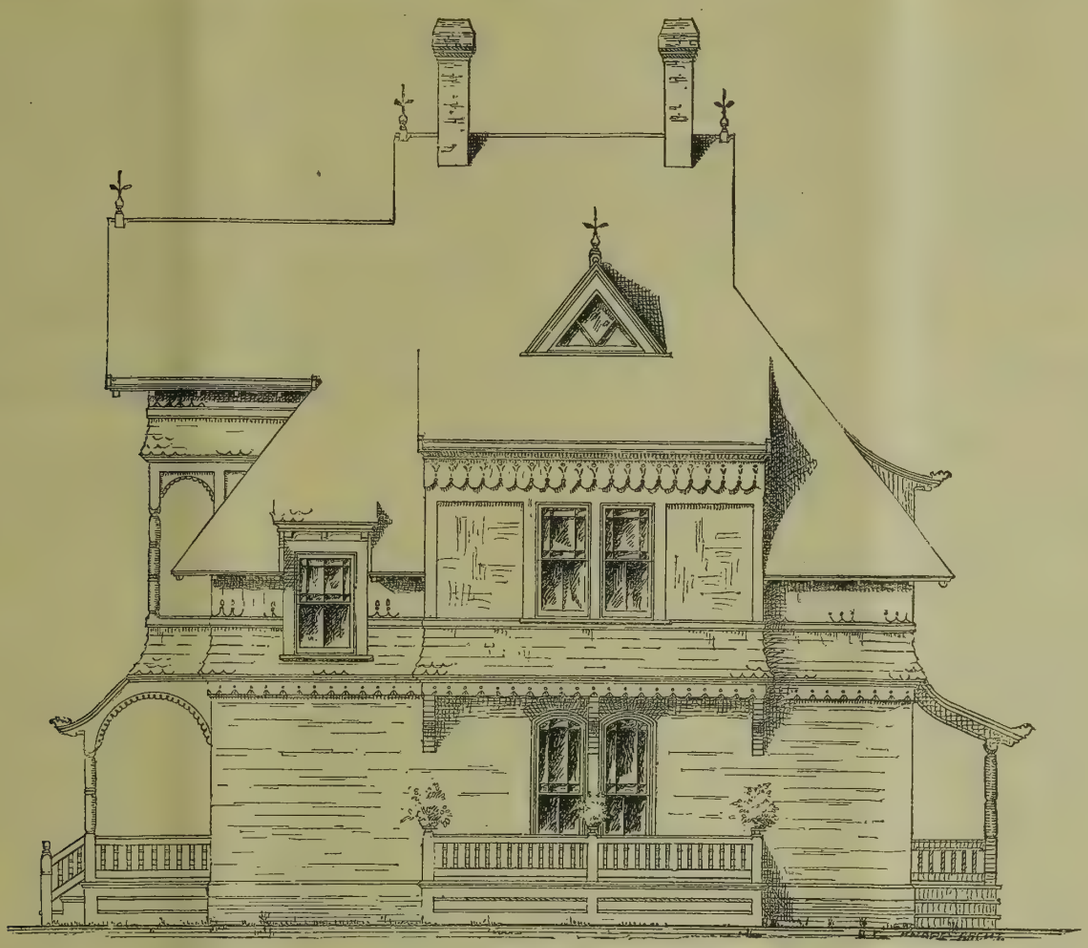
Design for a Low-Priced Cottage.

In the design presented on the opposite page, we have an admirable example of the picturesque and beautiful combined with simplicity and economy. The plan is compact and unbroken, but the outline is full of charming relief and effective variety.

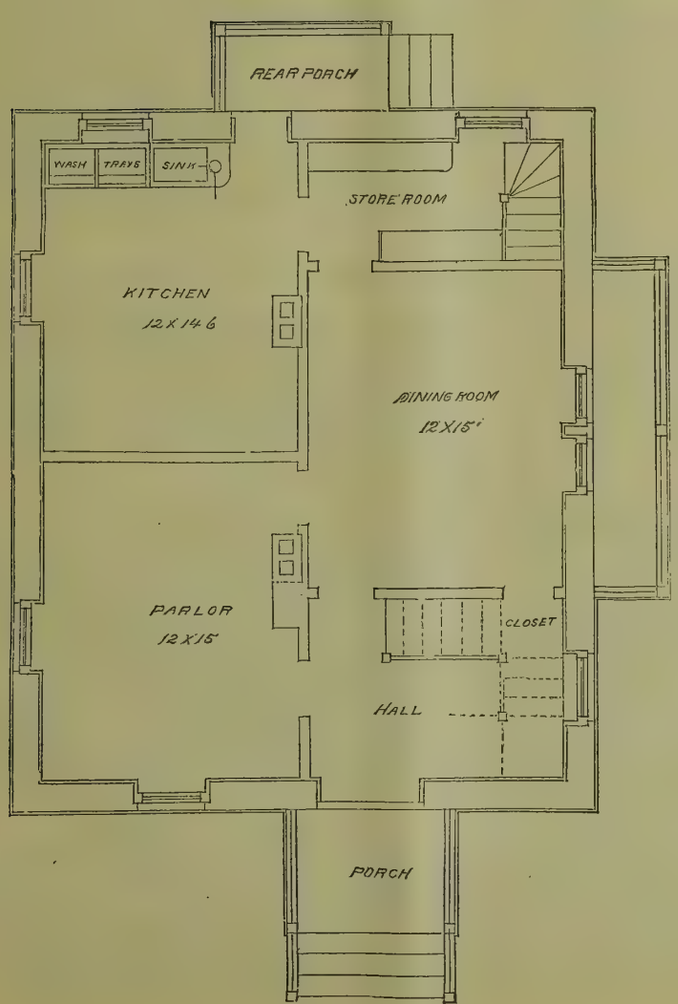
The first story is intended to be constructed of native stone, with brick facings to the openings. The exterior finish is quite clearly indicated by the side elevation, which is presented rather than the front because of its affording a better view of the roof construction.

An examination of the floor plans will show the best arrangement that can be devised for so small a cottage. The rooms are all of fair size, very conveniently accessible, and ample closets are provided. A stairway leads from the second-story hall to the attic, where a bedroom may be finished off. A cellar extends under the entire building, the outside entrance to which is underneath the rear porch.

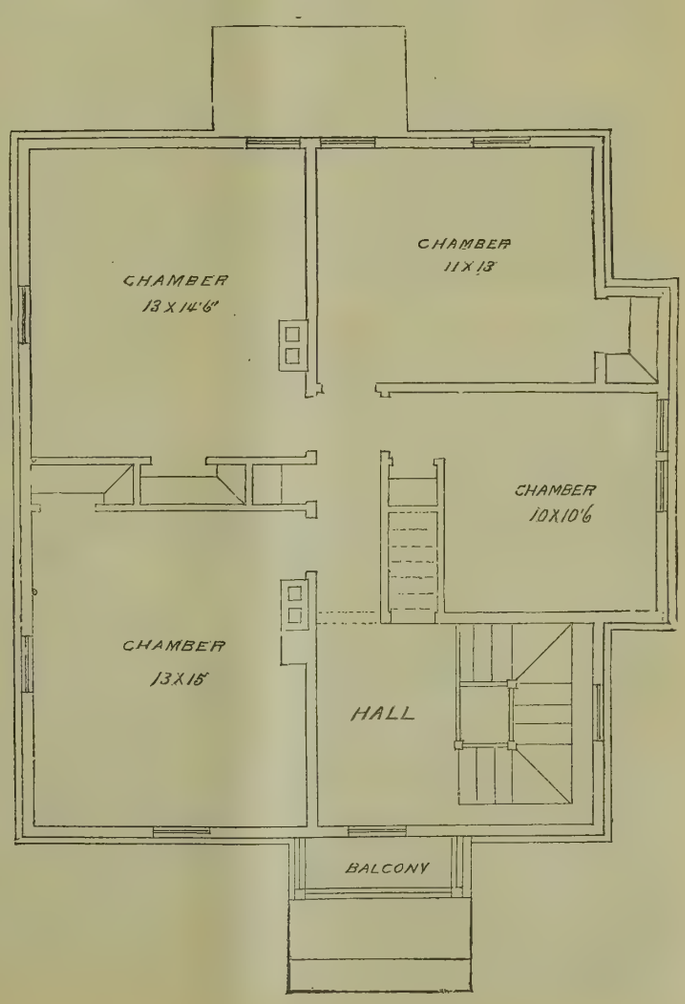
The estimated cost of this cottage is $2,500. The architect is Mr. H. G. Knapp, of 332 West Forty-eighth street, New York.



DESIGN FOR A COTTAGE, COSTING $2,500---SIDE ELEVATION.



First-Floor Plan.



Second-Floor Plan.

Statistics of the American Iron Trade.

From the annual report of James M. Swank, Secretary of the American Iron and Steel Association, we are enabled to glean the following facts and figures respecting the state of the American iron trade during the year 1881:

The production of the leading articles of iron and steel in the United States in 1881, is given in the following table in comparison with the production of the same articles in 1880. With the exception of iron rails, our production of every article enumerated was larger in 1881 than in 1880, or in any other year of our history.

Products.	Net tons—1880.	Net tons—1881.
Pig iron	4,295,414	4,641,564
All rolled iron, including nails and excluding rails	1,838,906	2,155,346
Bessemer steel rails	954,460	1,330,302
Open-hearth steel rails	13,615	25,217
Iron and all other rails	493,762	488,581
Kegs of cut nails and spikes, included in all rolled iron	5,370,512	5,794,206
Crucible steel ingots	72,424	89,762
Open-hearth steel ingots	112,953	146,946
Bessemer steel ingots	1,203,173	1,539,157
Blooms from ore and pig iron	74,589	84,606

The total production of pig iron in the United States in 1881 was 4,641,564 net tons, or 4,144,254 gross tons. (A net ton is 2,000 pounds, and gross ton is 2,240 pounds). The production was less than had been generally anticipated. It was a little more than 8 per cent greater than that of 1880, which was 4,295,414 net tons. The production of 1880 was 40 per cent greater than that of 1879, which was 3,070,875 net tons. The production was distributed in the following territorial divisions, the Northeast including the New England States, New York and New Jersey; the Southern States, Maryland and West Virginia; while the Western States begin with Ohio, and include Missouri and Colorado.

Territorial divisions.	Net tons of 2,000 pounds—1879.	1880.	1881.
The Northeast	359,992	612,388	585,188
Pennsylvania	1,607,763	2,083,121	2,190,786
The South	287,725	397,301	471,540
The West	812,895	1,197,604	1,382,336
The Pacific Coast	2,500	5,000	11,714
Totals	3,070,875	4,295,414	4,641,564

The production of spiegelcisen increased slightly in 1881 over previous years, the quantity produced in 1881 being 21,086 net tons. This country makes remarkably slow progress in the production of this essential raw material in the manufacture of Bessemer steel. Both foreign and domestic ores are used in its production in our furnaces. The following table shows the production of spiegeleisen since 1875:

Years.	Net tons.
1875	7,832
1876	6,616
1877	8,845
1878	10,674
1879	13,931
1880	19,603
1881	21,086

The following table shows in net tons the quantity of pig iron produced in each of the years 1879, 1880 and 1881 with bituminous coal, anthracite coal and charcoal, it being understood that the second of these classifications is not absolutely accurate, as coke is used as a mixture in many anthracite furnaces:

Fuel used.	1879.	1880	1881.
Bituminous	1,438,978	1,950,205	2,268,264
Anthracite	1,273,024	1,807,651	1,734,462
Charcoal	358,873	537,558	638,838
Totals	3,070,875	4,295,414	4,641,564

The consumption of pig iron in the United States in 1871 can be approximately ascertained. We produced 4,144,254 gross tons, and imported 464,430 tons. We had in stock at the beginning of the year 407,730 tons of domestic pig iron and 164,404 tons of foreign pig iron. The total supply was 5,180,818 gross tons. At the close of the year we had on hand 188,300 gross tons of domestic pig iron and 9,953 tons of foreign pig iron, which, being deducted from the total supply, gives us 4,982,565 gross tons as the probable consumption of the year. In the annual report of the association for the year 1880, published in July, 1881, the consumption of 1880 was estimated at 2,990,415 gross tons—the element of the calculation being the same for that year that is taken above for 1881. An increase of 1,000,000 gross tons in one year in our consumption of pig iron is a most remarkable fact. About one-third of this vast increase was used in the production of Bessemer steel; the remainder was required to supply the miscellaneous iron and steel works of the country.

Of the 701 furnaces in the United States on December 31, 1880, there were 446 in blast and 255 out of blast; of the 716 on December 31, 1881, there were 455 in blast and 261 out of blast. In 1881, there were built 26 new furnaces, and the construction of 25 others was commenced, but not completed. In the same year 12 furnaces were abandoned.

Boiler Inspections for June, 1882.

The one hundred and eighty-ninth monthly summary of the reports of the Hartford Steam Boiler Inspection and Insurance Company's inspectors is given below, and will repay a careful perusal. From it we learn that 2,142 visits of inspection were made and 4,535 boilers were examined. The number of thorough annual internal inspections reached a total of 1,803, and 364 boilers were proved by hydrostatic pressure. The whole number of defects found which were considered sufficiently serious to be reported, was 2,898, of which number 661 were considered to be of so grave a nature as to impair the safety of the boilers in which they were found. The number of boilers condemned was 44. The usual analysis of defects is given below:

Nature of Defects.	Whole Number.	Dangerous.
Cases of deposition of sediment	311	56
Cases of incrustation and scale	442	43
Cases of internal grooving	26	12
Cases of internal corrosion	109	21
Cases of external corrosion	160	49
Broken and loose braces and stays	88	58
Settings defective	87	15
Furnaces out of shape	105	27
Fractured plates	174	70
Burned plates	72	39
Blistered plates	311	36
Cases of defective riveting	297	48
Defective heads	38	26
Leakage around tubes	214	81
Leakage at seams	164	18
Water gauges defective	64	8
Blow-out defective	22	10
Cases of deficiency of water	9	4
Safety valves overloaded	31	7
Safety valves defective in construction	18	8
Pressure gauges defective	154	25
Boilers without pressure gauges	2	0
Total	2,898	661

New Publications.

An Important Publication.—The *Northwestern Lumberman*, of Chicago, is now engaged in the compilation of a new directory of all the saw mills in the United States and Dominion of Canada, which stupendous undertaking it expects to have completed in December next. The event will be signalized by the publication in January, 1883, of a mammoth extra number of the *Lumberman*, which, its publishers claim, will be the largest single copy of any trade journal that has ever been published. It will contain about 200 pages, and it is now announced that an edition of 30,000 copies will be printed for distribution among lumber and mill men all over the world. An edition of 20,000 was first announced, but the publishers assure us that the number of saw mills developed by their canvass thus far, so greatly exceeds their expectation that the extra 10,000 copies will be required to cover the ground over which they intend to distribute this mammoth number. Besides the list of saw mills, which will be printed in full, this extra number will contain the *Lumberman's* tenth annual review of the white pine lumber and shingle product of the Northwest, giving the production in detail of each saw and shingle mill, with comparative statements, showing the amounts of lumber and shingles manufactured each season for ten years, with stocks of logs and lumber carried over at the close of each season, etc. It will also contain carefully drawn plans, elevations and specifications for the construction of model saw and planing mills, showing all the improvements made in mill architecture, construction and arrangement of machinery, with illustrations of all the latest improvements in the way of machines for sawing and dressing lumber. The new directory will also be published in book form, and besides the name and post-office address of the owner or operator of each mill, will give its average daily capacity, whether run by steam or water power, and the kind of lumber manufactured. The list will be arranged in alphabetical order by States, territories and provinces, with the towns also arranged alphabetically in each. The price of the book has not yet been fixed, but will be announced in due time. Advertisers who desire to avail themselves of the opportunity to reach all the saw mills at once, presented by the *Lumberman's* mammoth extra, will do well to secure space at an early date.

Description, with Illustrated Diagrams, of Eight New Elegant and First-Class Residences, located on Lenox Hill, on Park avenue, and on Sixty-ninth street. William A. Hankinson, Builder, 213 W. Thirty-first, New York.

To those who may be desirous of acquiring the ownership of a commodious, finely located and artistically constructed house, an examination of the eight houses described in the above title will repay the trouble. The details of construction, which are in all respects of a high order of merit, are given in pamphlet form, a copy of which may be obtained by any one who may be interested as an intending purchaser. The location on Lenox Hill is one of the most popular sites in the city, being on high ground, and in close proximity to Central Park, and already greatly improved by the erection of many elegant residences. They were constructed from designs furnished by Messrs. Lamb & Wheeler, well-known architects of this city. The fronts are brown stone and brick artistically arranged, relieved with elegant bay-windows and architectural outlines of a pleasing character. Special provision has been made for securing excellent lighting, ventilation and drainage. The interiors are finished in a manner to correspond, from new and original designs by the same architects.

Building; an Architectural Monthly. Published by William T. Comstock, 6 Astor Place, New York. (Advance sheets).

We have received from the publisher specimen sheets of a new monthly journal, to be devoted to architecture, the first issue of which is promised for October 15, 1882. The new journal will contain 16 pages of the size of the Manufacturer and Builder, of which several will be devoted to full-page illustrations of architectural designs. The specimen before us contains a full-page design, with elevations and floor plans, representing a sketch of a cottage costing about $2,500. This illustration is a very attractive and creditable one. The reading matter is fresh and interesting. *Building* is printed on fine paper and in very good style, and promises to become a valuable addition to the list of American class papers. We wish its enterprising publisher much success with his new venture.

Lovell's Business and Professional Directory of Ontario for 1882. Published by John Lovell & Son, Montreal, Canada. Price, $6.

The above work is a very carefully compiled and complete business directory of the province of Ontario, and will be found to be very serviceable to all who have business connections with that section. The work comprises 1440 pages, and embraces no less than 1,733 cities and towns in Ontario. The arrangement is alphabetical, both as to localities, names, business and professions. An apparently very complete business directory of Montreal is one of the valuable features of the work.

We are in receipt of the Annual Trade Review of the *Columbus Daily Enquirer-Sun*, of Columbus, Ga., and the New England Fair Supplement to the *Worcester Evening Gazette*, of Worcester, Mass. They are representative of the commercial and manufacturing interests of these progressive cities of the South and East, and denote characteristic and commendable enterprise on the part of the publishers in spreading abroad facts regarding these places, of interest to every one taking pride in the growth of the industries of the country. The papers before us are models of typography, and profusely illustrated with cuts of manufacturing establishments and other important buildings and machinery. The Columbus paper has a fine bird's-eye view of that interesting city.

OTHER PUBLICATIONS RECEIVED.

Report of the Atlantic and Gulf Coast Canal & Okeechobee Land Company, March 22d, 1882. Philadelphia. 1882. From the Chief Engineer.

Summary Statement of the Imports and Exports of the United States for the month ended June 30, 1882, and for the twelve months ended the same, compared with the corresponding periods of 1881. Prepared and published by the United States Bureau of Statistics.

"Little Playmates." Set of twelve instrumental pieces of music from F. W. Helmick, 180 Elm street, Cincinnati, O.

Our Little Ones and the Nursery. Russell Publishing Co., Boston, Mass.

One of the brightest juvenile publications that come to our desk is *Our Little Ones and the Nursery.* It is a prettily illustrated magazine, and full of interesting matter for the children, who look for it as a welcome visitor every month. The subscription price is very low—only $1.50 per year, and what parent is there that cannot afford this trifling amount to make the little ones happy. It is a publication pure and instructive.

This department is intended to furnish, for the benefit of all our readers, information on any subject of a scientific or technical character falling within the field of The Manufacturer and Builder. *Any of our readers possessing additional or more correct information than that which we give relating to the questions, are cordially invited to communicate it to us for publication. We also request that all questions or answers be written on separate pieces of paper, and addressed to the Editor.*

QUESTIONS.

(3083) Fusible Alloys.—Will you be able to give me some formulas for making fusible alloys?—E. L., Brooklyn, N. Y.

(3084) Longevity in Different Trades and Occupations.—Can you refer me to any reliable facts as to the longevity of persons engaged in different trades?—A. M. B., New Brighton, Pa.

(3085) Horse-Power of Belting.—Can you give me a safe rule for getting at the power transmitted by leather belts? and for the reverse—that is, the width of belt necessary to transmit a certain power?—E. L., Brooklyn, N. Y.

(3086) Corrections in Printers' Proofs.—I write to ask information as to whether it is a generally admitted rule or custom for printers to charge for alterations made in reading the proof? I had a pamphlet printed some few weeks ago, and made some alterations and additions on the proof sheets, which I thought were necessary to make. The size of the pamphlet was not increased, but I was surprised to find the bill much larger than what I had contracted for, the increase being charged to the item of time for corrections. I would be obliged to you to learn if this is customary, or if the printer has taken advantage of my inexperience to make an unlawful charge?—L. W. S., Germantown, Pa.

(3087) Absolute Temperature.—What is meant by the expression "absolute temperature"?—D. E. D., Lowell, Mass.

(3088) Cloud Formation by Expansion.—I have often thought of asking what may appear to be a trivial question, but it has nevertheless puzzled me to account for. On opening a bottle of beer, stoppered as is usually the case with patent stoppers, a white cloud will invariably make its appearance in the neck of the bottle. Can you explain the cause of this?—G. B., Tullytown, Pa.

(3089) Water Pyrometer.—Can you refer me to an account of the action of what is called the water pyrometer, for measuring the heat of furnaces, etc.?—E. Y. E., Lansing, Mich.

(3090) Scale of Hardness.—In reading your late descriptions of minerals, I find you use the expression, "hardness, 3, 5," etc. How is this determined? or how are these numbers fixed?—F. D., Jr., Allegheny City, Pa.

(3091) A Singing Soldering-Iron.—I would like you to explain a very curious thing that I have noticed, if you can. About a week ago I was doing a piece of soldering, and carelessly laid my iron down, when I heard a clear humming noise, which would keep on for a while, then stop, and then commence again. I found at last that it came from the iron. To make sure, I lifted it when the sound stopped. I laid it down again in the same place, the handle on the zinc-lined top of my work-table, and the copper bit resting on the edge of a lead anvil, when the singing noise commenced again. I have asked some friends about it, but they cannot explain it. I have tried repeatedly to make the iron sing for the satisfaction of the thing, but I cannot always succeed, though once in a while when I happen to lay it down right, and the bit is the right heat, it starts off at once, and keeps it up for five or ten minutes.—E. B., Jr., Brooklyn, N. Y.

(3092) Vulcanized Rubber and Vulcanite.—What is the difference in the preparation of ordinary vulcanized rubber and hard rubber, or vulcanite?—M. B. L., Los Angeles, Cal.

(3093) Velocity of Light.—What are the most reliable figures for the velocity of light? I find the figures of different authorities vary somewhat.—O. W., Fort Wayne, Ind.

(3094) Works on Railroad Construction.—We shall esteem it a very great favor if you will kindly inform us if there are any hand-books or standard works on railroad construction that we might advantageously read. We are at present gang foremen, but are qualifying ourselves for grading and general superintendents respectively. We get the Manufacturer and Builder regularly, and will be pleased to see your advice at an early date.—A. and S., Holyrood, Newfoundland.

(3095) Pressure of Alcohol Vapor at 212°.—In subjecting a strong alcoholic liquid for some time in a closed vessel to the action of steam at 212°, so that the steam would surround the vessel on all sides by an outer jacket, what pressure would I have to provide against in the vessel containing the alcohol? I had thought it would be the same, as the steam is at atmospheric pressure, but have been informed that I am wrong.—J. McM., Frankfort, Ky.

(3096) Saw Teeth for Tar-Board.—I want to saw tarboard for friction wheels, but find it very difficult to cut smoothly and nicely, and without using up a great deal of power. I want to know what kind of saw to use, and how to run it, whether much or little set.—T. T. T., Williamsport, Pa.

(3097) Chicory in Coffee.—How can I detect readily whether ground coffee is adulterated with chicory?—W. H. B., Galt, Ont., Canada.

REPLIES.

(3083) Fusible Alloys.—The so-called fusible alloys are usually composed of bismuth, tin and lead in varying proportions. They present the curious anomaly of composite metals fusing at temperatures very much below the melting point of any of the metals composing them. The best known of these alloys perhaps is that of Rose's. It is made of:

Bismuth	50 parts by weight.
Tin	30 " "
Lead	20 " "

and fuses at 212° Fah. Darcet, a French chemist, who has made a very thorough study of the fusible alloys, gives the following formulas for preparing a number of them, which may be found useful to this inquirer.

No. 1.—Bismuth, 70; lead, 20; tin, 40. Softens at 212° Fah. without melting, and can be kneaded with the fingers.

No. 2.—Bismuth, 80; lead, 20; tin, 60. Softens at 212° Fah., and is easily oxidized.

No. 3.—Bismuth, 80; lead, 20; tin, 40.

No. 4.—Bismuth, 160; lead, 40; tin, 40.

No. 5.—Bismuth, 90; lead, 20; tin, 40.

These three alloys become more or less soft at 212° Fah. No. 4 becomes softer than either No. 3 or No. 5.

No. 6.—Bismuth, 160; lead, 50; tin, 70. Becomes almost liquid at 212° Fah.

No. 7.—Bismuth, 80; lead, 30; tin, 40. Becomes liquid at 212° Fah., but not very fluid.

No. 8.—Bismuth, 80; lead, 40; tin, 40. Very liquid at 212° Fah.

No. 9.—Bismuth, 80; lead, 70; tin, 10. Becomes soft at 212° Fah., but does not melt.

An alloy of equal parts of bismuth, lead and zinc is fusible at 212° Fah. These fusible alloys are rendered much more fusible by the addition of mercury. Mackenzie's fusible alloy, which can be rendered liquid by friction, is made by melting 2 parts of bismuth with 4 parts of lead, and pouring the molten metal into a crucible containing a small quantity of mercury. The amalgam formed solidifies on cooling, but if a fragment be broken and the two pieces are rubbed together they melt readily. The alloy of Rose, above mentioned, can be made to fuse at the temperature of the body (98.5° Fah.) by adding to it one-16th part, by weight, of mercury. This compound is used for taking casts. A composition for silvering the insides of glass globes, is made after the following formula:

Bismuth	2 parts.
Tin	1 part.
Lead	1 "
Mercury	10 parts.

An alloy that is often used for the amusing experiment of the fusible teaspoon, is made after the following formula:

Bismuth	8 parts.
Tin	3 "
Lead	5 "
Mercury	1 or 2 "

A spoon made of this alloy, when plunged into a cup of hot tea or coffee, melts down. By varying the proportions named in the above examples, it will be possible to secure an alloy having any desired degree of fusibility.

(3084) Longevity in Different Trades and Occupations.—Information of the kind asked for by this correspondent must be sought for in the official reports of various countries. A statement of results from French statisticians bearing on this subject, has lately been made by Dr. Felix M. Oswald, in an article on longevity published in the *Popular Science Monthly.* In France, he states, where the tabulation of comparative statistics is carried further than anywhere else, the healthfulness of the principal town trades has been ascertained to decrease in the following order: House building, huckstering, hot-bed gardening (florists), carpenter and brick mason trades, street paving, street cleaning, sewer cleaning, blacksmiths, artisan-smiths (silver, copper and iron workers), shoemaking, paper-making, glass-blowing, tailoring, butchering, house-painting, baking, cooking, stone and gem cutting and grinding, operatives of paint and lead factories, weaving, steel-engraving—the wide difference between brick and stone masons being due to the lung-infesting dust of stone-cutting work, which, though an out-door occupation, is nearly as unhealthy as steel-grinding. Lead-paint makers have to alternate their work with jobs in the tin-shop, and after all can rarely stand it for more than fifteen years. Needle-grinders generally succomb after twelve or fourteen years. The human lungs seem able to eliminate the impurities breathed by street and sewer cleaners, for in London, as well as in Paris and Marseilles, the followers of both trades rank high among the long-lived classes. Hucksters somehow manage to outlive city gardeners as well as shop-keepers; among the Hecubas of the Paris Market-Hall not less than 218 had passed their threescore and tenth year. Preaching, he adds, and, strange to say, pettifogging, are the healthiest of all the learned professions; their lung exercise may have something to do with it, for lecturing teachers outlive the "silent" teachers (dancing masters, etc.) Physicians die early; nature revenges herself upon her leagued adversaries, for druggists and barbers (in many parts of Europe synonymous with village quacks) are likewise short-lived; but sextons live to a good old age. There must be a mistake, he thinks, about the supposed danger of graveyard effluvia. Art still increases the value of human life, but not its length; the greatest modern masters of tune and color died in their prime, like the greatest poets. Inspiration in all its forms would seem to be a flame that consumes the human clay more quickly than the fire of affliction.

(3085) Horse-Power of Belting.—Wilkinson, in his very practical manual on "Steam Economy," has calculated a number of rules bearing on the subject of this inquiry, and from which we give the following: The writer's experience has safely confirmed a rule he learned in his youth namely, "that a velocity of 750 feet per minute per 1 inch of belt width, for single leather belts; or 500 feet per minute per 1 inch of double belts, will safely transmit 1 horse-power, and secure excellent economy in belting." To find the horse-power of belts, the velocity and width being given, divide the actual velocity by the velocity per horse-power, as above (750 or 500 feet per minute), and multiply by the width of belt in inches, namely, for a 40-inch double belt, running 2,500 feet per minute:

$$\frac{2{,}500}{500}=5\times40=200 \text{ horse-power.}$$

To find the width of belting necessary for a given horse-power, the velocity and horse-power being known, divide the velocity by the velocity per inch, obtained as above, and divide the horse-power by the product; namely, a belt running 2,500 feet per minute is required to transmit 200 horse-power. How wide should it be?

$$\frac{2{,}500}{500}=5\,;\quad \frac{200}{5}=40 \text{ inches.}$$

The above rules are confined to main driving belts, have no application to shifting belts, and they cover, too, all conditions referring to angles. It is presumed, also, that under the most favorable conditions, a much higher duty than these rules give would be obtained. The Page Belting Co., of Concord, N. H., gives the following formula on belting:

$$\text{Inches wide}=\frac{\text{No. of horse-power}\times36{,}000}{\text{Velocity in feet}\times\frac{1}{3}\text{ contact length in inches.}}$$

In Cooper's collection of "Facts and Figures" occurs the following:

$$\text{Width in inches}=\frac{\text{No. of horse-power}\times7{,}000}{\text{Velocity in feet}\times\text{contact length in feet.}}$$

(3086) Corrections in Printers' Proofs.—The printer's extra charge for work on alterations and corrections is not only customary, but is entirely just in principle, as our inquirer will acknowledge if he will think it over a little. Mackellar, in his "American Printer," puts the case in this way: "Let us remind authors that every correction made on their proof, that is a variation from the copy as furnished to the printer, is charged for according to the time required to make it. The justice of the charge is obvious; yet, strange to say, there is probably no item so frequently disputed by publishers. A man employs a mechanic to build a house according to fixed specifications, but in the course of its erection he improves or changes the plan, and orders certain portions to be torn down and rebuilt. Is the mechanic to bear the loss? Certainly not. So, when a compositor builds up his page of type according to the copy furnished, he is right in requiring compensation for alterations made in it. He is not to suffer for the author's desire to improve his intellectual edifice." Before a manuscript is brought to the printer, it should be as perfect as the author can make it. The compositor is bound to "follow copy, even if it goes out of the window." The only latitude allowed to him is in the correction of wrong punctuation or of obvious grammatical errors which his intelligence enables him to amend. After the matter has been read and corrected in the office, a proof is sent to the author, and if it corresponds with the copy, the compositor's responsibility is at an end. He has done all that he is paid for; and should the author desire any changes made in his matter, of course he must pay for them. Mackellar says on this point in another place: "Sentiments in print look marvelously differ-

cnt from the same ideas in manuscript; and we are not surprised that writers should wish to polish a little, nor do we object to their natural desire of amending or beautifying their mental products. But let them not forget that pay-day will come, when the item for alterations will loom out with startling distinctness in their bill. They found it easy in the proof to erase a word or two here, and insert a word or two there, without dreaming, perhaps, that in consequence of these little erasures and insertions the compositor would be compelled to alter and reconstruct much of his work. We know of a volume on which the alterations alone consumed time equal to one man's work for nearly two and and a half years. How unreasonable—nay, how transparently unjust, the expectation that the printer should give gratuitously the time and trouble requisite for the radical changes in the type which an author's whim or taste may demand." We have no doubt that the foregoing explanations will have convinced this inquirer of the entire justice of the printer's claim for compensation for alterations made in the proof. While, however, such charges are just in principle, it may be added that the item of "time" for alterations and corrections offers the opportunity for printers who are not strictly conscientious—and there are such printers, as we have discovered—to pile up unreasonable and extravagant charges where it can be done without fear of detection. If our inquirer thinks he has been thus imposed upon, he is advised to submit his manuscript and the printed copy to some friend who is experienced in such matters.

(3087) Absolute Temperature.—The expression "absolute temperature" will be understood from the following explanations: The experiments of Regnault respecting the rate of expansion of gases, have shown (taking air as the type of practically permanent gases) that the expansion of one volume of this gas, measured at 32° Fah., when heated to 212° Fah. under a constant pressure, is equal to 0.365; the ratio of the initial to the expanded volume being as 1 : 1.365. As the expansion is uniform with the rise of the temperature through the 180°, the expansion for each degree is

$$.365 \div 180 = \frac{1}{493.2};$$

taking the volume at 32° Fah. as equal to 1. The same uniform rate of expansion holds sensibly for temperatures higher than 212°. It has been verified experimentally up to 700° Fah. under one atmosphere pressure. It is inferred that, conversely, air would *contract uniformly* under uniform reductions of temperature below 32° Fah., until, arriving at 493.2° Fah. below the freezing point, or 461.2° Fah. below zero, the air would be reduced to a state of collapse, without elasticity. This point in the Fahrenheit scale has thus been adopted as that of absolute zero, standing at the foot of the natural scale of temperature; and the temperature measured from absolute zero, or—461.2° Fah., is called the *absolute temperature*. Accordingly, if a given weight of air at 0° Fah. be raised in temperature to 461° Fah. under a constant pressure, it will be expanded to twice its original volume; and if heated from 0° Fah. to twice 461°, or 922°, its original volume is trebled. The absolute zero point by the different thermometric scales is as follows:

Reaumur	—219.2°
Centigrade	—274°
Fahrenheit	—461.2°

(3088) Cloud Formation by Expansion.—This inquirer has not asked so trivial a question as he imagines. There is often a deal of philosophy in little things, and he has been puzzling himself about a very pretty but simple philosophical experiment. The phenomenon which he has observed is nothing else than the formation of a cloud of water vapor by expansion, precisely analogous to its formation on a vastly larger scale in the atmosphere. The vacant space above the liquid in a beer bottle, contains carbonic acid gas, saturated under considerable pressure with aqueous and alcoholic vapors. When the stopper is suddenly removed, the confined gas, released from pressure, suddenly expands. Expansion is accompanied by chilling, and consequently a portion of the vapor that the gas could carry as such when under pressure, is precipitated as a dense white cloud that fills the neck of the bottle. The formation of clouds in the atmosphere is generally caused in an analogous manner. Tyndall, in his interesting volume on "Forms of Water," explains this point in his usual interesting manner as follows: "Unconfined air, heated at the earth's surface, and ascending by its lightness, must expand more and more the higher it rises in the atmosphere. This ascending air is chilled by its expansion. Indeed, this chilling is one source of the coldness of the higher atmospheric regions. And now fix your eye upon these mixed currents of air and aqueous vapor which rise from the warm tropical ocean. They start with plenty of heat to preserve the vapor as vapor; but as they rise they come into regions already chilled, and they are still further chilled by their own expansion. The consequence might be foreseen. The load of vapor is in great part precipitated, dense clouds are formed, their particles coalesce to rain-drops, which descend daily in gushes so profuse that the word 'torrential' is used to express the copiousness of the rainfall." A phenomenon of the same kind as that related by this inquirer, can be produced by placing a receiver of humid air on the plate of an air pump and exhausting rapidly. Having more room, the air expands, cold accompanies the expansion, and as a consequence a portion of its vapor is precipitated in the form of a dense cloud which fills the receiver.

(3089) Water Pyrometer.—The following is a description of the water pyrometer as improved by Dr. Siemens: The water is contained in a copper vessel capable of holding rather more than a pint. The sides and bottom of the vessel are fitted with an outer casing or jacket, the interspace of which is filled with felt, by which any radiation of heat from the vessel is prevented. A mercurial thermometer is fixed in the vessel and immersed in the water. It is fitted with a small sliding scale in addition to the ordinary scale, which is graduated and figured with 50° to 1° of the ordinary scale. Six solid copper cylinders are supplied with the pyrometer, each of which is accurately adjusted so that its capacity for absorbing heat shall be one-50th of that of a pint of water. In using the pyrometer, a pint of water is measured into the copper vessel, and the sliding scale is set with its zero at the temperature of the water as indicated by the ordinary scale of the thermometer. One of the copper cylinders is placed in the furnace or the hot-air current the temperature of which is to be measured, where it is left for a space of time, of from 2 to 10 minutes, according to the intensity of the heat to be measured. Having been thus raised to the temperature of the furnace, or current, the cylinder is withdrawn and quickly dropped into the water; the temperature of the water is raised at the rate of 1° per each 50° of the temperature of the copper cylinder. The rise of the temperature may then be read off direct on the pyrometer scale. Add to the temperature thus noted the observed initial temperature of the water, and the sum is the exact temperature required. For very high temperatures, cylinders of platinum are recommended in place of those of copper.

(3090) Scale of Hardness.—Hardness is one of those physical qualities which mineralogists make use of to aid in the identification of minerals, the same as they make use of color, luster, streak, cleavage, specific gravity, etc. It (hardness) is the resistance which substances offer to being scratched or abraded by others. It is a purely relative quality—for a body which is hard enough to scratch certain bodies, may in turn be scratched by many others—that is, it may be hard with reference to some and soft with reference to others. Hardness, as may be inferred from the above, is determined by attempting to scratch one body with another. The mineralogist, for his determinations, uses a convenient scale of hardness, first suggested by the German mineralogist Mohr. This scale is represented by numbers from 1 to 10, the lowest number designating the softest, and the highest the hardest substance. It is as follows:

1. Talc.	6. Feldspar.
2. Gypsum.	7. Quartz.
3. Calcspar.	8. Topaz.
4. Fluorspar.	9. Corundum.
5. Apatite.	10. Diamond.

In determining the hardness of a substance, its surface is tested first with one and then with another fragment of the minerals of the scale, until one is reached which appears to give the right result, which is then designated by the appropriate number. Thus, a substance having the same hardness as quartz, would be designated by 7; the hardness of a body which will scratch feldspar, but which will be scratched by quartz, will be expressed by 6.5, etc. The diamond is the hardest of known substances, and is not scratched by any other. This property affords one of the safest means of readily determining the true gem from imitations, which, when stones are cut, are often very difficult to distinguish from each other.

(3091) A Singing Soldering-Iron.—This correspondent has accidentally struck just the right conditions for performing one of the most curious acoustical experiments. The experiment in question is a familiar one in the physical lecture-room, where it is known as Trevelyan's rocker. The cause of the singing sound is the contact of two metals of different temperatures. The resting of the heated iron on the edge of the lead plate causes the lead to expand, raising a slight elevation in its surface at the point of contact; this slightly tilts the iron, and another contact is made with the lead, which expands and tilts it back to its first position. Thus a rocking motion is imparted to the iron. These vibrations will be imperceptible to the eye, but they follow each other so rapidly that they produce a musical note. Mr. Trevelyan, who first observed this phenomenon accidently, like this inquirer, studied the subject carefully, and devised the instrument called "Trevelyan's Rocker," by which the experiment can be performed very satisfactorily. It consists of a bar of iron, one side of which is beveled and provided with a groove along its whole length, forming two sharp edges. The bar is provided with a long handle. When this device, which resembles a poker, is heated and laid across a block of cold metal, with the end of the handle resting on the table, it at once commences to sing, like our inquirer's soldering-iron. As the poker gradually loses its heat, the singing becomes weaker and weaker, and finally ceases. By placing an iron rod, terminated by two knobs, across the poker (thus weighting it), the weight of the rod causes the vibrations of the poker to become slower, and the rocking motion which causes the sound will be made visible to the eye by the movements of the rod and its knobs.

(3092) Vulcanized Rubber and Vulcanite.—Both of these valuable products of the arts are prepared by the process of vulcanizing—that is, treatment with sulphur at a high temperature. The difference between them is due to different proportions of the substances employed, differences in the temperature employed in the manufacture, etc. The ordinary vulcanized rubber of commerce is said to be made of a mixture of 1 part of sulphur, 14 of whiting, 2½ of white lead, and 2 of litharge, to 16 of rubber, which is exposed to a temperature of from 265° to 270° Fah. for several hours. The proportion of the foreign ingredients varies very much with the use to which the material is to be put. In many forms of rubber goods the proportion of foreign materials considerably exceeds that of rubber. Hard rubber, or vulcanite, of which the invention is due to Austin G. Day, of Connecticut, contains a considerably larger percentage of sulphur. Nelson Goodyear obtained a patent in 1851 for a hard and inflexible product composed of rubber, sulphur, magnesia, etc. The material obtained by this process was useful for certain purposes, but it was too brittle to be of great value. Day obtained his patent August 10, 1858, for a compound composed of two parts of rubber to one of sulphur, which, when heated to about 275° to 300° Fah., became hard, flexible and elastic. It came into rapid and extensive use, and is one of the most valuable materials of the modern arts. The same inventor (Day) has since invented a variety of methods for vulcanizing rubber in combination with resins, oils, tar, etc., by which he obtains products of a great variety of qualities. One of the most valuable of these is known as "Kerite," and is said to be admirably adapted for the insulation of telegraph wires.

(3093) Velocity of Light.—Several recent investigations respecting the velocity of light have been made with all the refinements of modern scientific research, and it is reasonable to suppose that these should approximate more closely to the truth than the older investigations. The most trustworthy results are generally conceded to be those of Lieut. Michaelson with sunlight. His calculations gave him a velocity of 186,500 miles per second.

(3094) Works on Railroad Construction.—We have caused to be mailed to these inquirers a list of the publications relating to railway construction, etc., issued by our esteemed contemporary the *Railroad Gazette*. Among these we have indicated with brackets the "Road-Master's Assistant and Section-Master's Guide," by Wm. S. Huntington (revised by Charles Latimer). This is a reliable and excellent work, and we think covers the ground desired by these correspondents. There are other works on the list also that may be found serviceable, but of this our inquirers will be best able to judge by a careful reading of the circular sent. The *Gazette* publications are all sound and reliable.

(3095) Pressure of Alcohol Vapor at 212°.—This inquirer is wrong in supposing because water and alcohol are heated to the same temperature their vapors will exert the same pressure. Alcohol boils at 173° Fah., and consequently its vapor exerts the same pressure as that of boiling water at 212° Fah., namely 14.7 pounds per square inch; or the same pressure (14.7 pounds) that turpentine vapor exerts at its boiling point—315° Fah. Consequently, in a confined space, the alcohol vapor, subjected to a temperature considerably above its normal boiling point, will exert a considerably higher pressure. Clark gives a table of the pressures of vapors of different substances, from which we make the following extract: At the temperature of 212° Fah., at which water boils under one atmosphere of pressure; in other words, at which the pressure of the vapor of boiling water is 14.7 pounds per square inch, the pressure of the saturated vapors of the several liquids given below are as follows:

	Per square inch.
Vapor of water at 212° F., pressure	14.7 pounds.
" alcohol " "	32.6 "
" ether " "	95.17 "
" chloroform " "	45.54 "
" turpentine " "	2.61 "

(3096) Saw Teeth for Tar-Board.—In this connection we cannot do better than to go to headquarters and consult a standard authority on all that concerns saws, and their choice and management. Grimshaw recommends, in his "Supplement" to his first work on saws, that tar-board be cut with teeth of hand rip-saw outline, one-12th inch high, 7 points per inch, with plenty of set; plate 18 gauge (which is .049 inch if it is Birmingham, and .0403 if it is the American; the former presumed).

(3097) Chicory in Coffee.—Dick gives the following directions on this point, which will probably be found to fully answer this inquirer's purpose: Place a spoonful of the ground coffee gently on the surface of a glass of cold water. The pure coffee will float for some time, and will scarcely color the water; the chicory, if any be present, will rapidly absorb the water and sink to the bottom, communicating a reddish-brown tint to it as it descends. Or, a spoonful of ground coffee may be placed in a small bottle of cold water and shaken for a moment. If the sample of coffee is pure, it will rise to the surface and hardly tinge the water; while if the coffee is adulterated with chicory, the latter will fall to the bottom and color the water as above named. Burnt sugar, however, will give a very similar coloration to the water, and this forms the basis of some of the so-called "coffee essences" or "extracts."

THE MANUFACTURER AND BUILDER.

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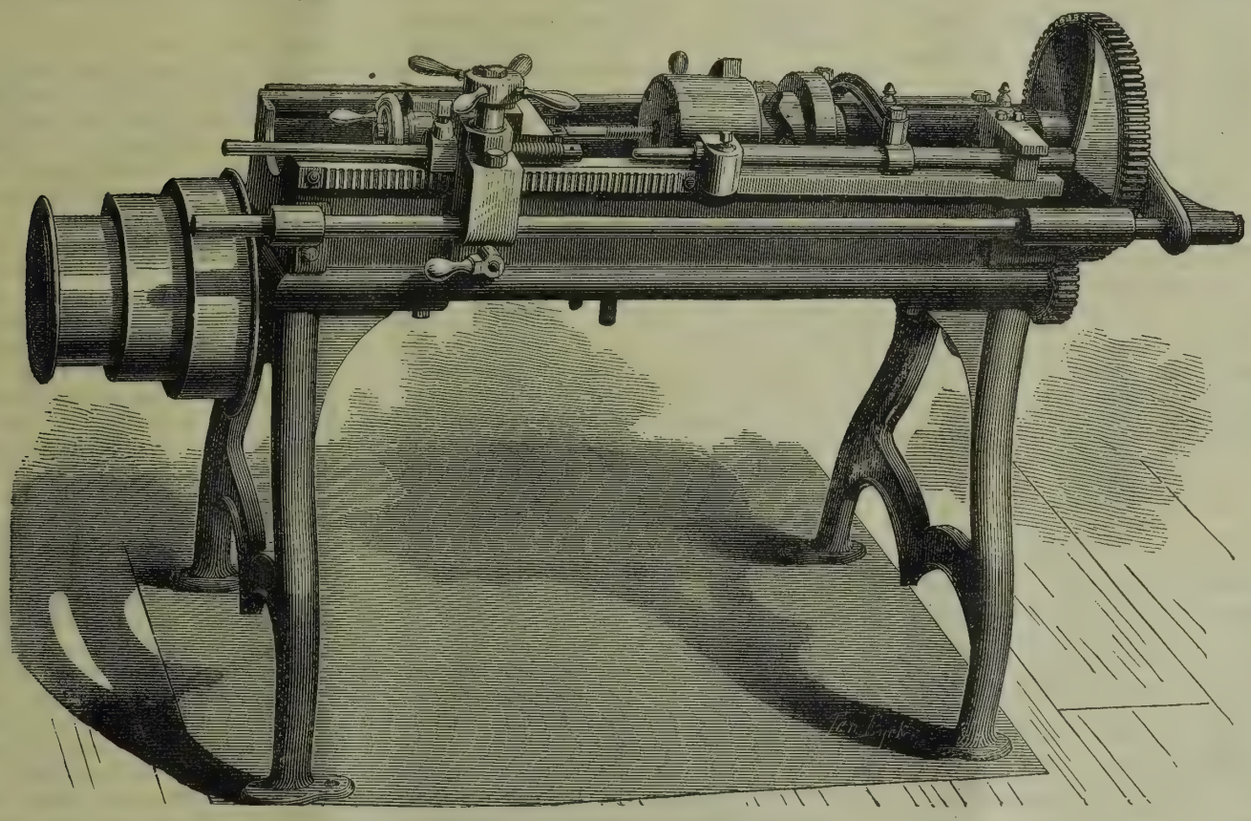
Wood's Improved Center Bolt-Cutter.

To insure accurate fits in making bolts for finished work, it is necessary that the face of the nut should be exactly at right angles with the axial line, to effect which it has hitherto been considered necessary to chase the threads on the screw-cutting lathe. The objections to this method are that it requires skilled labor to properly grind and set the tool, to watch the work and constantly test each piece to insure uniformity of size as the chasing tool makes its last cut. In spite of all the precautions that can be taken, however, it is found to be next to impossible to thread a number of bolts in a screw-cutting lathe to exactly the same diameter. Variations in size will occur which will interfere with accurate fitting, so that the procedure is objectionable because it is slow, imperfect and comparatively costly.

The device of Mr. Wood named in the title of this article, is intended to do away with the above named objections, and for this purpose he has proceeded on the principle of applying centers to a bolt-threading machine for holding the work exactly as it is secured in lathes. The finished bolts are thereby retained with the same axial accuracy as in the last mentioned machines, and may be threaded by the dies with the certainty of the line of the thread having correct relations to the axial line of the piece.

The method of Mr. Wood's procedure is as follows: The bolt to be threaded is first centered and turned in the usual manner, as if to be cut in a screw-cutting lathe. It is then placed in the centers of the machine, and, guided only by the longitudinal movement of the movable center and the carriage, is run into the dies. For different lengths of bolts, the arm in connection with the carriage is disengaged from the bar, and the carriage is moved to the desired relative position, and again secured. The bolt is arranged upon centers (see cut) between the roughened faces of two cams, which are adjusted by two slides, relatively to the diameter of the piece; the tendency of the bolt to rotate with the cutting device causes, by contact, a corresponding motion of the cams, which finally, by their shape, offer a rigid resistance, and thus firmly hold the work.



IMPROVED CENTER BOLT-CUTTER.

By the aid of the machine, an ordinary hand is capable of threading bolts as accurately and nicely, and with greater precision in size and fit, than the most skillful workman with a chasing tool in a lathe. From six to ten times as many bolts can be cut in a given time as by the last mentioned means. Absolute uniformity of size is the result of this method of holding the dies rigidly in the solid ring of the cutter head, thus avoiding the spring or variations often noticeable in machines in which the set of the dies is given by levers, or devices uncertain in positive results. Another feature of merit in this machine is the automatic arrangement by which the dies, after being set to the desired length of thread, are instantly opened at that point, and the bolt-carrier thrown back to receive a new bolt. This arrangement, besides insuring uniform length of cut, avoids the danger of accident or breakage owing to running the holder against the dies, through inadvertance or inattention of the workman. One operater, through this device, readily keeps two or more machines continually at work.

This improvement of adding centers for the axial holding of bolts to bolt-threading machines, which we have now fully described, was patented in the United States by Mr. Wood, February, 10th, 1874, and similar protection has also been obtained in Canada and several European countries, and has come into extensive use in many of the prominent railroad shops and locomotive works throughout the United States and Canada. They are made of three sizes, ranging in cut from five-16ths of an inch to 2½ inches. The makers keep in stock dies and taps of common sizes, and make to order any size and style of thread, hardened and finished, ready for immediate insertion in their machines without fitting.

The following are a few of the many prominent manufacturing concerns who have these center bolt-cutters in use: Brooks Locomotive Works, Dunkirk, N. Y.; Rhode Island Locomotive Works, Providence, R. I.; Taunton Locomotive Works, Taunton, Mass.; W. A. Harris, and the Armington & Sims Co., engine builders, Providence, R. I.; Athol Machine Co., Athol, Mass.; Mason Machine Works, Taunton, Mass.; T. Shriver & Co., New York city; Rogers Locomotive Works and Danforth Locomotive Works, Paterson, N. J.; Baldwin Locomotive Works, Philadelphia, Pa.; New York, Lake Erie & Western Rail-

road shops at Hornellsville, N. Y., and Buffalo, N. Y.; Pennsylvania Railroad shops, Altoona, Pa.; Pittsburg, Fort Wayne & Chicago Railroad shops, Fort Wayne, Ind.; Chicago, Milwaukee & St. Paul Railroad shops, and St. Paul, Minneapolis & Manitoba Railroad shops, St. Paul, Minn.

This machine is indispensable to locomotive and engine builders, or, in fact, to any shop where quantities of finished bolts are used. Further information will be furnished by addressing the George Place Machinery Co., 121 Chambers and 103 Reade streets, New York.

The Manufacturer and Builder.

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Theater Fires and their Lesson.

The recent destruction by fire, in an incredibly short space of time, of the Park Theater in this city, and of another, but less conspicuous, place of amusement, in the same manner, which occurred a few days later, are circumstances still fresh in the public mind, and, like all disastrous events, have been the absorbing theme of conversation, and have afforded newspaper writers by the score the opportunity of spilling a vast amount of ink in ventilating the subject, without much prospect that any good will come of it. On two points all appear to be of one mind—first, that it was a most fortunate circumstance that the fires in question occurred at a time when the buildings were empty, thus obviating what would otherwise have been a frightful loss of human life; and second, that radical changes in the construction and interior arrangements of such buildings are imperatively necessary, in order that they may be made safe to those who frequent them. As the vast majority of theaters are now constructed and furnished, it is no exaggeration to say that they are little else than *death-traps*, and that those who venture into them are at all times in imminent peril.

We shall venture in the following some views upon the causes that render theaters so extremely dangerous, and some suggestions as to what changes in construction and interior arrangements should be adopted to make them comparatively safe; for, notwithstanding the fact that the fire-hazard of the play-house will always be great, there is no question that with the adoption of certain well-known precautionary measures, and certain changes affecting the construction of the auditorium and the stage, theaters could be made, not safe against fires, but so safe that their crowded audiences could in all cases escape without loss of life from fire or smoke. Injuries, and even loss of life, by the trampling under foot and crushing of the weak in the frantic rush of a panic-stricken crowd, cannot of course be provided against; but the moral effect of the knowledge that the personal danger from fire was provided against, would go far towards lessening the liability of a panic among the audience.

The extreme liability of theaters to destruction by fire will be understood from the following brief statements: The large space called the stage is encumbered with great masses of inflammable materials, such as laths, boards and other wood-work, quantities of gauze, canvas of the scenes, paper, pasteboard—in brief, a huge collection of the most readily inflammable materials. In the midst of these masses of combustible material are numerous gas flames, and the parts of the heating apparatus. The danger is increased by the fact that much of this combustible material is not stationary, but is being constantly shifted about, raised and lowered, etc, thus greatly increasing the liability of contact with the gas flames. In addition to all this, the popularity of spectacular plays, introducing the effects of fire, in various more or less realistic ways, to gratify a vitiated taste, has added enormously to the dangerous character of theaters.

Mr. Hexamer, an able insurance expert, who has interested himself greatly in the subject of the prevention of fires in theaters, concisely states the case as follows: "We are particularly careful in places filled with combustible materials, to enter them with closed lanterns only, carefully avoiding the use of open lights and candles. On the stage, on the contrary, guns are fired off, torches swung, fireworks set off, while at the same time scenes of lath and canvas are let down, etc." A German writer on the same subject says: "One who has been behind the scenes during the performance of a spectacular piece, and found himself suddenly enveloped in a sea of fire, and has noticed how a force of men are engaged in extinguishing (by means of wet rags suspended on long poles) the sparks which have settled on the scenery; who has noticed how, notwithstanding all care, fiery objects fly from their prescribed course; or has seen how a piece of firework, too strongly loaded, throws everything into confusion; one who sees this for the first time, cannot overcome the feeling of astonishment and fear; and this, when viewed from the audience, is no more than is common in spectacular pieces."

The foregoing explanations will have made it clear that even with the exercise of the utmost care, a theater stage is never free from the danger of fire; and when to this we add the factor of carelessness from incompetent or reckless employés, the danger is greatly increased. It explains also, from the immense accumulation of inflammable materials upon the stage, the terrible rapidity with which the flames spread, unless they are discovered and extinguished at the instant of their occurrence. After the first few minutes, all efforts to stop the spread of the fire are utterly useless, as has been shown in repeated instances.

To lessen the fire risk, therefore, the first thing to do is, manifestly, to lessen the inflammability of the trappings and paraphernalia of the stage, and to render them as nearly fire-proof as practicable. To the question, whether this can be done, we answer unqualifiedly, Yes!

The same writer we have quoted before, is authority for the statement that the experiment of making certain pieces of decoration of incombustible material has been tried many times, and successfully. The flies, which, from their contiguity to the border lights, are consequently most exposed, could be made of fine wire gauze, with the interstices filled with any incombustible filling, and then painted in the usual manner. They would be more expensive and heavier than those generally used at present, but their entire security against fire is an overwhelming argument in favor of requiring their use. The wood-work and canvas, as well as the flies and the scenery, could at very little expense be impregnated with fire-proofing materials and painted with materials that would render them practically incombustible. Any chemist to whom this problem were given could suggest a dozen ways in which it could be done.

Now, a few suggestions as to the construction of theaters; and those which we offer have received the endorsement of competent insurance experts, namely: In its construction, a theater stage should be as nearly like the shaving vault of a planing mill as possible. The rear and two sides of the stage (including the green and dressing rooms) should be enclosed by thick brick walls; the roof and roof trussing should be made as nearly as possible fire-proof; the wall dividing the stage from the auditorium should be of brick, starting from the foundation, and should be broken by the stage opening and orchestra doors only. Above the stage an arch should be sprung, and the wall should be carried up on this above the roof. The joists and flooring boards of the stage should not extend beyond one foot of this wall, and those of the parquet should merely extend to the wall, and not through it. The doors in this wall should be of wood *lined* with iron, as such doors will retain their form in a fire without warping long after iron doors have become warped and useless.

A wire drop-curtain, to divide the stage from the auditorium, is imperatively necessary. They are in successful operation, and only need to be properly constructed to work properly. Their failure in several well-known cases is no proof of their inutility, but simply of negligence or improper construction. That this curtain should serve its intended purpose, it is necessary that it should be kept in proper order, and that it be automatic. The first condition should be kept effective by raising and lowering it before and after every performance, and the second would avoid

the necessity of depending on the coolness of the employé whose business it would be to lower it in case of fire. It is hardly necessary to add that *all* gas lights upon the stage and in the rooms should be protected by wire baskets and screens. Fire-extinguishing appliances in the shape of fire-buckets, kept constantly filled with water, should be provided in abundance, not only on the floor of the stage, but also in the rigging loft—the most dangerous part; and plugs with hose attachment should be placed in every part of the building—the stage, the galleries, and the loft. These could be readily made attractive in appearance, should be plainly marked with large letters, and should have their hose attached ready for instant use. Automatic sprinklers, supplied from a large reservoir of water located on the roof of the building and crossing the upper part of the stage and rigging loft, should also be provided for additional safety.

So much for the preventive measures; and now a few words as to the safety of audiences. The loss of life in theater fires is from two causes, first, suffocation by smoke, and, second, by trampling and crushing in the stampede to escape. Comparatively few victims of theater fires are burned to death, as they are suffocated by the dense volumes of smoke long before they are touched by the fire. As our theaters are usually constructed, there is a large ventilator situated above the main chandelier in the center of the ceiling of the auditorium; there is consequently a great draft of heated air from all parts of the house towards the ventilator. Towards this, in case of fire, the flame and smoke is at once carried, and the body of the auditorium is speedily filled with it.

To get rid of the smoke in the auditorium, is to do away with the greatest danger in theater fires; and to do this, it is necessary to form a counter draft, which, in case of fire, will be strong enough to overcome the combined draft of the doors and ventilator. This can be accomplished by a chimney or flue on the top of the stage; and several very satisfactory plans for this purpose have been suggested, which we may describe and illustrate in a subsequent article.

The danger of crushing and trampling during the escape from a burning theater, cannot in the nature of things be perfectly provided against. To lessen this danger, the corridors should in all cases be so constructed as to widen towards the exit doors, which should in all cases be numerous and made to open outwards. Each gallery and floor should have its own outlets separate from all others, so that one crowd shall not precipitate itself upon another on a lower floor. The number of galleries should be limited to *two* at most—that is, the "balcony" and the "family circle." The system of lighting the auditorium should be separate from that of the stage, to avoid the extinguishment of the lights in case of fire, and as an additional precaution, all the corridors should be provided with oil lamps.

We have indicated in the foregoing a number of important details, to which, if careful attention is paid, the *safety of audiences* in the frequent event of theater fires will be ensured. That such horrible calamities as have repeatedly happened, in which hundreds of human lives have been lost, should be possible, is an utter disgrace to our boasted civilization. They can, and should, be made impossible, if the constituted authorities would do their duty in the premises.

New Applications of Electricity.

Aside from the various phases of the problem of electric lighting, and the transmission of power over considerable distances by means of dynamo-electric machines and metallic conductors, which may be considered as the most important field of electrical investigation at present engaging the attention of scientific men, there are several others, which, though not so prominent, nevertheless promise to lead in time to results of great interest and practical value.

Of these we will mention first, as perhaps the most novel and interesting, the effect of electric light upon vegetation, which has been made the subject of a number of highly interesting experiments by Dr. C. W. Siemens. In his annual address this year as president of the British Association for the Advancement of Science, he refers to the fact that he has lately extended his experiments in this direction. He reports the very important fact that in experimenting upon wheat, barley, oats, and other cereals sown in the open air, there was a marked difference in the growth of the plants influenced and those uninfluenced by the electric light. This fact, he adds, was not apparent till toward the end of February, when, with the first appearance of mild weather, the plants under the influence of an electric lamp of about 4,000 candle-power, placed about 16 feet above the surface of the ground, developed with great rapidity, so that by the end of May they stood about 4 feet high, with the ears in full bloom, while those not under its influence were under 2 feet in hight, and showed no signs of ears. From these and other equally convincing observations of Dr. Siemens, there can be no doubt that the electric light exercises a very decided influence upon the growth of vegetation, and the interesting inquiry presents itself, whether the fact is susceptible of practical utilization in agriculture in hastening and aiding the growth and development of food crops. Thus far the experiments have been made upon a comparatively limited scale, but the results obtained have been so signally successful that their repetition upon the large scale would appear to be warranted.

Another of the new applications of electricity which appears to promise valuable practical results in the near future, is the electric railway, which, though it attracted an unusual degree of attention when first brought to notice in this country about one year ago, has since that time been allowed to drop out of sight and out of mind, by the more absorbing interest created by the numerous experiments in electric lighting. In Europe, on the other hand, this direction of electric research has not been forgotten nor lost sight of, but, on the contrary, is engaging careful attention. The electric railway in Berlin, described in this journal last year, has been in successful operation since its completion about a year or two ago, and the experience gained in its operation, and in that constructed and operated at the Paris Electrical Exhibition, has proved so encouraging that their gradual introduction seems to be pretty well assured.

Dr. Siemens, than whom no one is more competent to speak authoritatively on this subject, speaks in most favorable terms of the future possibilities of this system. Referring to the subject in his presidential address above mentioned, he states that in the electric railway first constructed by Dr. Werner Siemens at Berlin, in 1879, electric energy was transmitted to the moving carriage, or train of carriages, through the two rails upon which it moved, these being sufficiently insulated from each other by being placed upon well creosoted cross-sleepers. At the Paris Electrical Exhibition, the current was conveyed through two separate conductors, making sliding or rolling contact with the carriage.

In a new electric railway now in course of construction in the north of Ireland, from Port Rush to the Giant's Causeway, a distance of 12 miles, a separate conductor will be provided, according to Dr. Siemens' statement, by the side of the railway, and the return circuit completed through the rails themselves, which do not therefore require insulation. Secondary batteries will be used to store up the surplus energy created in running down hill, to be restored in ascending steep inclines, etc.

Dr. Siemens expresses the opinion that the electric railway possesses great advantages over horse or steam power for towns, in tunnels, and in all cases where natural sources of energy, such as waterfalls, are available, though he admits that it cannot in its present condition of development compete with steam propulsion on ordinary railways. The transmission of power by means of electric conductors has, he points out, the additional advantage over other means of transmission, that (where the resistance of the rails is not very great) the maximum power is communicated to the locomotive when it is commencing to work or encountering an extraordinary resistance (that is, when its motion is at its minimum).

Other facts and inferences are stated in relation to the subject, but the above are sufficient to establish the extreme probability that the electric railway is destined in the not remote future to become an important institution. It would be proper in this connection to allude to the secondary battery as an electrical invention now in course of development, which is destined also to play an important role in the ever-increasing applications of this protean agent, but this topic we discuss more at length in another article.

A Hint to Ingenious Men and Women.

As a matter of general interest to inventors, and which deserves to be widely known, we give place here to an account of the legacy of John Scott for the encouragement of deserving inventors.

The legacy in question consists of a considerable sum of money, which the city of Philadelphia holds in trust under the legacy of the testator, the interest of which is to be used for the encouragement of "ingenious men and women who make useful inventions." The legacy provides for the distribution of a medal inscribed, "To the most deserving," and also of a money premium of twenty dollars, to such persons whose inventions shall be adjudged worthy of the same. The Board of City Trusts, who are the wardens of this fund, recognizing their inability to properly superintend its distribution in accordance with the wishes of the testator, have wisely invited the coöperation and assistance of the ancient and honored Franklin Institute, which body has accepted the responsibility, and now desires that ingenious men and women who have made useful inventions, shall be advised of the existence of the bequest and of the manner in which they may be benefited by it.

To this end, we may explain that the institute has delegated to its Committee on Science and the Arts the duty of investigating the merits of all inventions that may be referred to it by applicants for this award. These investigations will be made by the committee free of charge, and if the verdict is a favorable one, the award of the medal and premium will be recommended to the institute. To guard against any possibility of mistakes, either of oversight on the part of the committee or of misrepresentation on the part of the applicant, such recommendations will only be reported to the general body after having been duly advertised for the space of three months, in order to afford to possible objectors the opportunity of coming forward and making their statements to the committee. After these preliminaries have been complied with, the recommendation is reported to the institute. Should it be approved by the general body, it is then transmitted to the Board of City Trusts, which will order the issuance of the medal and premium in the name of the city of Philadelphia.

The award of such a testimonial in the manner above described is justly held in special honor. The fact that it is awarded, not promiscuously, or by favoritism, but with judgment and discrimination after careful examination at the hands of so eminently competent and respectable a body as the Committee on Science and the Arts of the Franklin Institute, gives it a peculiar distinction, which reflects honor upon its recipient. The report of the committee conveying the recommendation of the award, and giving the reasons therefor, likewise gives it an added value.

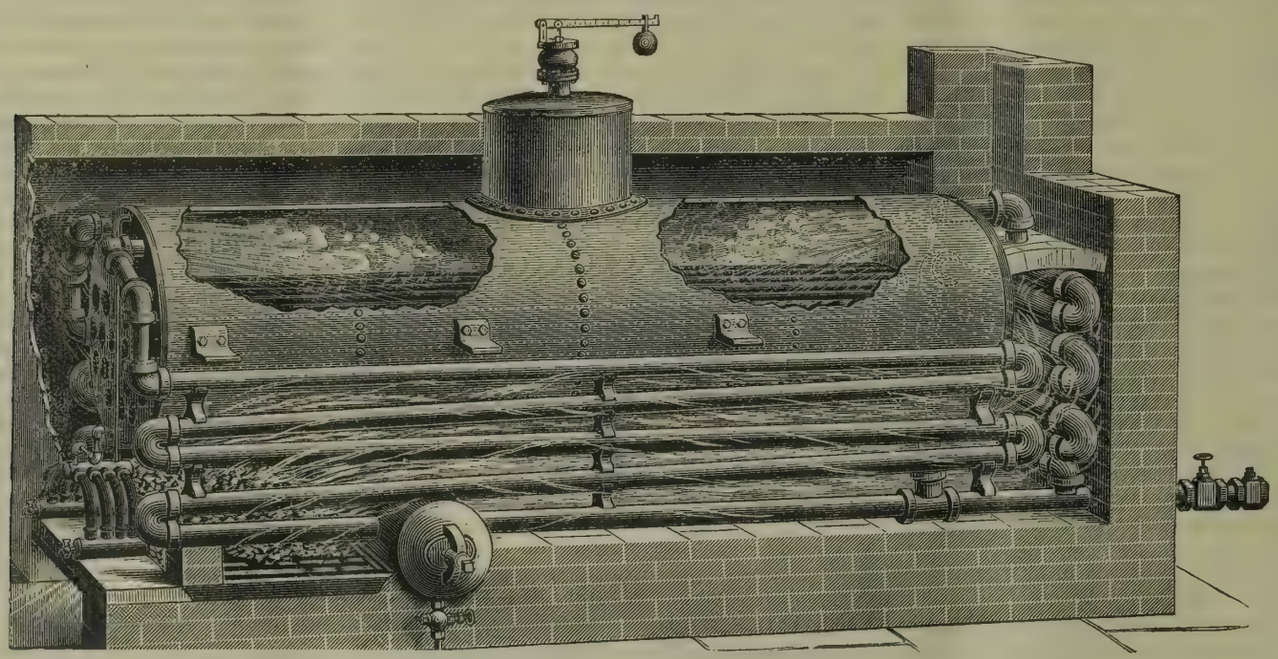
Our object in stating these facts has been to apprise ingenious men and women who make useful inventions, of this admirable opportunity of obtaining an honorable recognition of their ingenuity, without expense to themselves, and purely upon the merits

of their inventions. Such recognition may in many instances be of important service in turning the tide of success in the direction of many a worthy and struggling inventor. Those who may wish to avail themselves of the opportunity of profiting by this bequest, may secure all needful information by communicating on the subject with the Secretary of the Franklin Institute.

Economy in Steam Generation.

The accompanying illustration represents in an admirable manner one of the best modifications of the improved circulating and feed-water heating attachments to steam generators, devised by Mr. J. C. Stead, of 65 Kent street, Greenpoint, N. Y., of which we have taken the opportunity of speaking in previous articles in this journal.

So much importance attaches to the subject of economy in steam generation, that any system of boiler setting or construction that promises to accomplish a notable increase of duty, is worthy of careful attention on the part of steam users. The system devised by Mr. Stead is one of the few, out of the legion of inventions of this class, that has actually demonstrated its utility in practice. It has long since passed the conjectural or experimental stage, and though improved and perfected in numerous details since the time of its first introduction some six or eight years ago, these subsequent modifications in no wise affected, but, on the contrary, confirmed, the correctness of the principles involved in the original design. As it stands at the present time, the attachments of Mr. Stead can be relied upon in almost every situation where they are introduced, to realize an economy of from 25 to 50 per cent—estimated in saving of fuel, or in a corresponding increase of power. The attachments can be readily placed upon nearly all forms of steam generators in common use; they do not involve any radical changes, and have proved themselves to be very durable in service.



STEAD'S CIRCULATING GENERATOR AND FEED-WATER HEATER.—SIDE VIEW

For the information of those readers who may not have had the opportunity of seeing our previous articles relating thereto, we append a brief description of the essential principles of Mr. Stead's improvements, reference being had to the accompanying illustration. An inspection of this engraving, which represents a horizontal tubular boiler of ordinary pattern, with a portion of the brick-work and shell removed, will disclose, in the place of the ordinary brick bridge-wall, an iron drum, arranged at such a hight as to leave an effective space between it and the boiler for heating its contents, and connected by pipes with the steam and water spaces of the boiler. The purpose of this arrangement, and of the additional attachments about to be described, as will shortly be perceived, is to obtain a rapid and continuous circulation and an increase of evaporative effect, as well as to prevent the formation of scale, by the accumulation in the drum of sediment, which would otherwise attach itself to the boiler.

In addition to this combined water bridge-wall and mud drum, Mr. Stead introduces a continuous and connected system of circulating tubes along the sides of the boiler, similar coils at the front and rear ends, and a coil in the form of an arch within the fire chamber. These attachments are varied according to circumstances, in some cases one or the other of the coils being omitted, or a feeding coil at the bottom of the boiler being introduced, as circumstances may indicate.

These several attachments form together a continuous system of circulating tubes, connecting with both steam and water spaces of the boiler, which has for its object to effect a rapid and continuous circulation of the boiler water and the preliminary heating of the feed-water, by utilizing to its utmost all the available heat of the fuel, a large proportion of which is usually expended without useful effect, and the result of which is to effect a decided increase in steaming capacity, and incidental but important advantages resulting from the maintenance of a rapid circulation, such as uniform expansion and contraction of all parts of the boiler, freedom from attachment of sediment and scale, etc.

The lateral coils above spoken of consist of a system of tubes connected by return bends, masoned in between the pipes with fire brick. Being constantly filled with water, they largely reduce the liability of the masonry to burn out. The entire system of coils returns into the steam space of the boiler, as seen in the engraving.

The feed-water is admitted through the connection seen projecting from the rear of the boiler, entering at the lowest end of the lateral circulating coil, and after passing through the entire circuit, is discharged into the steam space of the boiler, where the circuit terminates. An automatic valve provided in this connection, prevents the feed-water from entering the boiler directly; but as soon as the action of the feed-pump ceases, the valve in question opens and admits the boiler water into the coil, thus maintaining the circulation unimpaired. The drum, it should be added, is slightly inclined towards the blow-out end, to facilitate the accumulation of sediment there, and from which it is blown out from time to time.

With ordinary care, experience has shown that these pipes and connections are very durable. To secure the best results, it is necessary that the boiler should have a good draught, as by reason of the very complete utilization of the heat the usual draught will be somewhat affected.

The inventor, from the experience gained in the use of the system, which has come into extensive use in leading manufacturing establishments throughout the country, invites the attention of steam users to the following meritorious features which he claims for it: "1st. The generator will save from 25 to 50 per cent of fuel, or give a corresponding increase of power. 2d. The water side walls prevent the fire brick from burning out. 3d. The water bridge wall does away with a brick bridge wall. 4th. As the water has to change through the mud drum or the bridge wall many times during the twenty-four hours, the mud and sediment fall to the lower end of the drum, and are blown off from day to day, according to the state of the water. 5th. The automatic valve being placed between the system of pipes and boiler, no feed-water, hot or cold, can enter the boiler until it passes through the system of pipes. The feed-water, whether feeding or not, enters the boiler through a distributing pipe and falls over the tube in a fine spray, thus keeping the tubes cool in case of low water. 6th. Should the water get low at any time, or all out, and the system of pipes and boiler become overheated, the water would have to pass through the pipes before entering the boiler. Should any explosion occur by feeding water, it would only affect the pipes, thus saving damage to boiler, etc. 7th. In the system of pipes, automatic valve and bridge walls, there is caused a rapid circulation from the bottom to the top and throughout the boiler, which keeps the water at an equal temperature, and causes the boiler to be equally expanded and contracted alike, thus doing away with repairs. 8th. Owing to the thorough circulation, the boiler is kept free from sediment and scale, and all scale previously formed is gradually removed. 9th. The steam is 20 per cent hotter. 10th. No repairs are necessary."

As regards the economy shown by the Stead circulating attachments, the following brief *resumé* of the results of a test made upon a tubular boiler at Faber's Pencil Works, at Greenpoint, will suffice to give our readers an approximate estimate. These results are given on the high authority of Prof. R. H. Thurston:

"*Conclusion.*—From the average results of the trial, it is concluded: 1st. That the horizontal tubular boiler tested at Faber's Pencil Works, Greenpoint, having the Stead bridge wall generator attached, exhibited an unusually high evaporative power, and equivalent to (*a*) 10.26 pounds of water per pound of anthracite coal, from and at 212° Fah.; (*b*) 11.67 pounds

of water per pound of combustible, thus utilizing 78 per cent of the heat generated by the combustion of the fuel. 2d. That the boiler exhibited a steaming capacity equivalent to 3.03 pounds of water evaporated per square foot of heating surface per hour, from and at 212° Fah., which, on the basis of 31 pounds, or ½ cubic foot of water to the horse-power, is equivalent to a duty of 1 horse-power from 12.33 square feet of heating surface, making the capacity of the boiler 62 horse-power. This is also exceptionally good. 3d. That the amount of priming, as measured, 0.26 per cent, is remarkable for a boiler having no superheating surface. The absolute amount of water primed is so small as to warrant the statement that the steam made was, practically, thoroughly dry."

It is worthy of notice in connection with the above, that the test in question was made with a boiler supplied with one of the earlier forms of Mr. Stead's attachments. Since then the inventor has made the important additions of lateral circulating tubes, water arch and back coil, the effect of which, he claims, would have been in this particular case to have raised the capacity of the boiler in question from 62 to 100 horse-power.

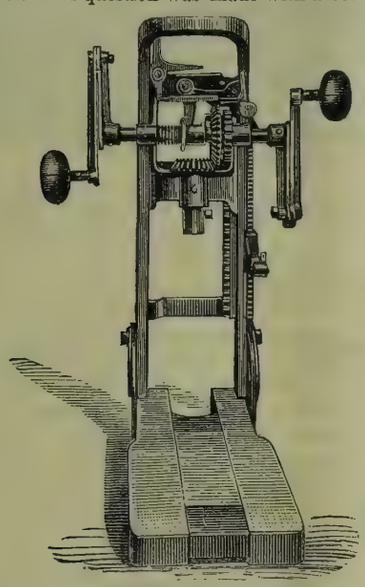


Fig. 1.

We commend the foregoing statements and claims to the careful consideration of our mechanical readers who are interested as steam users, in the important question of economy in steam generation.

Mr. Stead has been experimenting for years, in order to produce a pipe or sectional boiler which would overcome the defects of other sectional boilers, such as headers, rubber joints, wet steam, poor circulation and allowing the pipes to choke up. He has taken several of the best parts of his circulating generator and put them, together with other of his recent patents, on boilers, and as a result has succeeded in producing a very superior sectional boiler. He has had one in use now for fifteen months night and day, which shows 175 horse-power; grate surface, 5×6. Another is running showing 200 horse-power; grate surface, 5½×6. Still another is being put up, and in a short time will have some scientific tests made, when we will be pleased to place before our readers an illustration and full description, with tests.

We would add, as most convincing evidence of the great value of Mr. Stead's boiler, the fact that the American Heating and Power Company, of this city, after a thorough examination and investigation by practical tests of the steam generators in the market, have just placed two of Mr. Stead's boilers in their central station at 43 Gold street, this city.

PLASTER OF PARIS is made hard enough for a mold for metal castings by the use of 10 per cent of alum in the water used for mixing the plaster.

The Saunders Improved Automatic Boring Machine.

We represent in the accompanying illustrations several views of a recently patented device, which embodies a number of novel and ingenious features that render it a most convenient and useful tool. The device in question is the Saunders automatic boring machine, manufactured by the Wells Manufacturing Co., of Ashaway, R. I. While designed specially for the use of carpenters and builders, its utility, convenience and general superiority over other machines of a similar character, will be found serviceable by all having occasion to use them. Farmers, for example, who have hitherto used the ordinary hand auger, or other makes of boring machines, will be interested in reading the following description of this device. It is compact and portable, can be folded together so as to occupy comparatively little space in the tool chest; it operates with about twice the rapidity of ordinary machines of its class, and with great ease and convenience; it can be adjusted to any depth of hole to suit the operator; it returns itself automatically *without reversing the motion* of the crank, and before doing so clears the hole of chips. With this brief statement of its principal features of convenience and utility, we invite attention to the following details of its construction:

The cuts represent the machine with adjustable crank arms folded (Fig. 1) and with the same extended (Fig. 2), and the machine folded together (Fig. 3) for packing in the tool chest, or for transportation.

The principal features of the machine are, the frame, which is hinged and bolted at any desired angle to the bed by means of adjustable standards; a carriage within the frame, which carries the auger shaft; a latch for holding the carriage to the top of the frame, and a spring releasing the same; a clutch, clutch lever and clutch pinion gear for operating the forward and automatic reversal of the carriage (without reversing the motion of the cranks); a rack, shown upon the right, upon which the pinion gear travels; a step, or gauge, seen projecting from the lower right-hand side of the frame, and which, by sliding up or down, regulates the depth of the hole; a worm in the crank shaft, which, when it reaches the step or gauge in boring, causes a section of a nut to move towards the frame, pushing the clutch latch out, thus tripping the clutch lever and pushing the clutch through the shaft gear into the pinion gear (which is loose on the shaft), and throwing it into gear with the shaft (the bevel, or shaft gear, being fast to the shaft). Thus the carriage is caused to lift out of the hole without reversing the motion of the cranks.

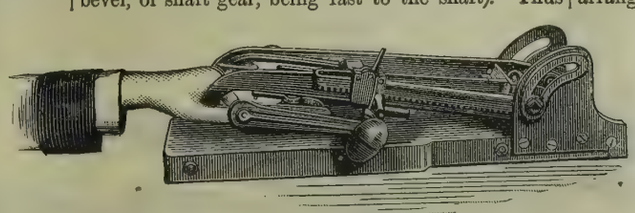


Fig. 3.

The operation of the device will be understood from the following, the machine being supposed to be in place on a log or joist ready for boring: The first operation is to press down on the latch seen near the top of the frame, which releases the carriage and allows the auger to drop to the log or joist. The gauge or step is then set at proper hight, to correspond to the depth of hole desired. Then the handles are grasped and turned. When the shaft has reached the gauge, the auger has reached the depth of the hole. The motion of the cranks is *not*, however, reversed, but their motion is continued in the same direction as before, and the worm in the shaft engages with a section of a nut in the gauge, the auger rotating three times in this fixed position without moving vertically, which causes the chips to be lifted from the hole. The section of the gauge nut by this time has traveled far enough towards the frame to trip the clutch latch from the clutch lever, by which the clutch is released and engaged with the pinion gear, by which the auger is automatically withdrawn from the hole, the cranks all the time being turned in the same direction. The carriage is carried upward by the reversing gear until the carriage latch engages with the catch at the top of the frame, which holds the carriage for another hole. According as the gauge is set, a series of holes of any desired depth will be bored.

Adjustable crank arms are provided, which are shown in the cuts, attached to the fixed cranks, for the obvious purpose of giving greater leverage, thus increasing the ease with which the machine can be operated in boring large holes. By using the fixed cranks, the speed of the bit will be correspondingly increased. The cuts show these adjustable arms folded and extended. The claim is made for this machine that it will perform nearly double the work of any other in a given time, and with no greater expenditure of work, or with even less.

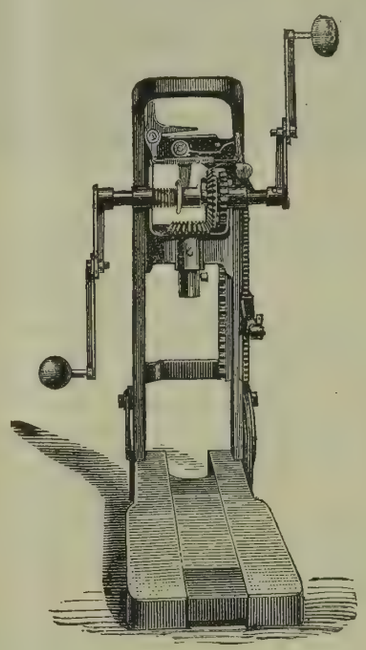


Fig. 2.

By inspecting the folded view of the machine, the arrangement of the angular stand will be seen, by which the machine may be adjusted to bore at any angle, and which being hinged, enables the machine to be folded together compactly for packing or transportation.

Respecting the materials and workmanship of the machine, we are informed that these are of the best, in order to give it the greatest serviceability. The cranks are of malleable iron, the two shafts and pins are of steel, and the cast work of the best quality. Hard wood is used for the wood-work, and nicely finished. All working parts are made to gauge, so that any part may be duplicated, if broken in case of accident, by application to the makers.

From the above description, the Saunders boring machine will be observed to embody peculiarities of design and construction which render it a superior and exceedingly handy device.

The Wells Manufacturing Co. have just filled an order for Canada, and have unfilled orders on their books for export to New Zealand, Australia and Mexico. They are increasing their facilities to 75 machines per day, and have recently placed an order with their machinists for 5,000 machines.

EXPERIMENTAL FARMS will be established by the Texas and Pacific Railroad along its line next season. The purpose of these farms will be to test the availability of lands for different farming purposes.

Improved Wood-Working Machinery.

The accompanying engravings and descriptions relate to special improved wood-working machines manufactured by Mr. C. B. Rogers & Co., of Norwich, Conn., and 109 Liberty street, this city. They combine to a high degree, in their design and construction, the elements of strength, simplicity and adaptation for their special uses.

Vertical Boring Machine (one spindle).—This machine (Fig. 1), recently constructed from new patterns, is especially adapted for agricultural works, cabinet-makers, wagon and carriage makers and builders, and is designed to meet a demand for a light but substantial tool, capable of easy and quick adjustment in all its parts.

The bit, which has a vertical throw of 12 inches, stands 7 inches from the post, thus admitting of a capacity to bore through the center of a 12-inch piece. By means of a peculiar and simple device in the connections with the treadle, a motion of 6 inches produces a throw of 12 inches on the spindle; the bit is carried up by means of a weight at the back end of the lever, a rubber cushion being fitted into the treadle to relieve any shock occasioned by a sudden return. The spindle is provided with a gauge collar at the upper end, and a stop rod at the side.

The table is raised and lowered by means of a screw and hand-wheel, and is pivoted to facilitate boring at any angle. The guide is adjustable to the center of the table and for boring at an angle, and can be removed from the position shown in the cut and reversed to the front.

Six bits are furnished of the following sizes, one each—$\frac{3}{8}$, $\frac{1}{2}$, $\frac{5}{8}$, $\frac{3}{4}$, $\frac{7}{8}$ and 1 inch. The tight and loose pulleys on the counter-shaft, which is attached to the machine, are $8\frac{1}{2}$ inches diameter, $3\frac{1}{2}$ inches face, and should be speeded to 500 revolutions per minute. Weight of machine, 800 pounds.

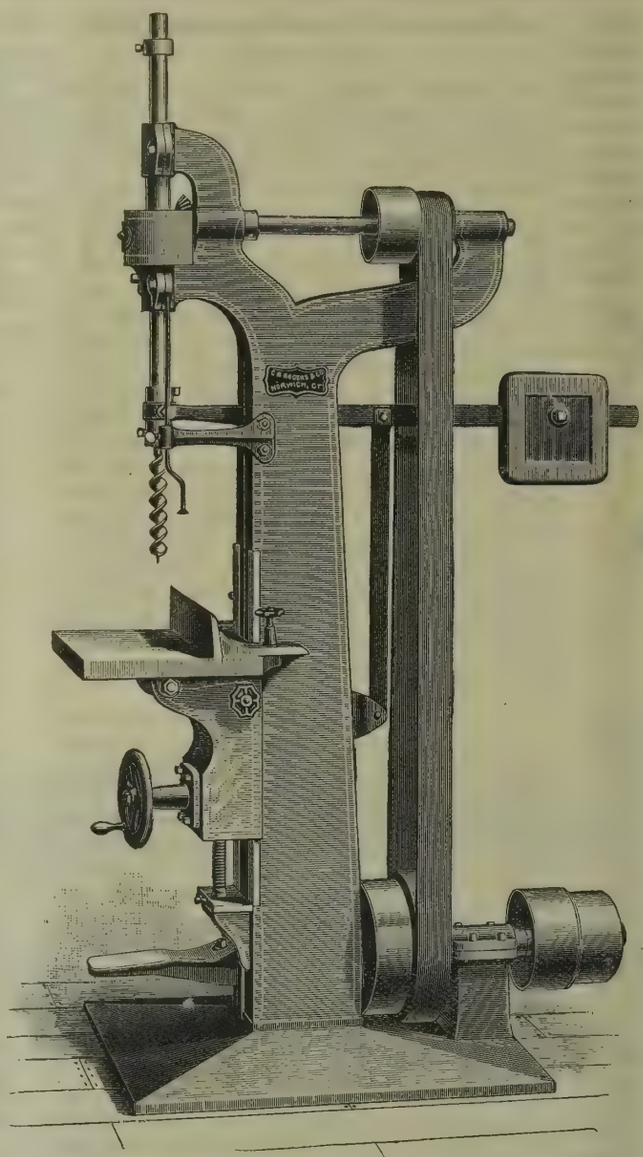


Fig. 1.—VERTICAL BORING MACHINE—ONE SPINDLE.

Pedestal Shaping Machine.—Fig. 2 represents the medium size, improved pedestal shaping machine of the same makers. This machine is made from entirely new designs, and embodies the latest improvements. It consists of a substantial square column, which, together with the base, and arms which hold the spindle yokes, is cast in one solid piece.

The spindles are steel, 1 inch diameter above the table, 17 inches apart, and run in boxes connected by a yoke, to keep in perfect line. Both boxes are self-oiling, and the lower step has a large oil-chamber with a take-up cap, in which the spindle runs, and heating is impossible with oil in the chamber. The spindles are raised and lowered by the hand-wheels in front, in easy reach of the operator. The top is hard wood, made of narrow strips, glued, to prevent warping and cracking, and is $3\frac{1}{2}$ feet square. In the column of the machine is a tool closet.

The makers furnish 2, $2\frac{1}{2}$ and 3 inch steel heads which can be used on this machine; also sash and door heads, and one set of 2-inch heads with straight cutters. A counter-shaft is also furnished, the tight and loose pulleys of which are $8\frac{1}{2}$ inches diameter, $3\frac{1}{2}$ inches face, and should make 1,070 revolutions per minute, giving heads 5,000. The machine weighs 700 pounds.

Details respecting the power required to run these machines, and other data, will be supplied on application to the makers, at the address given above.

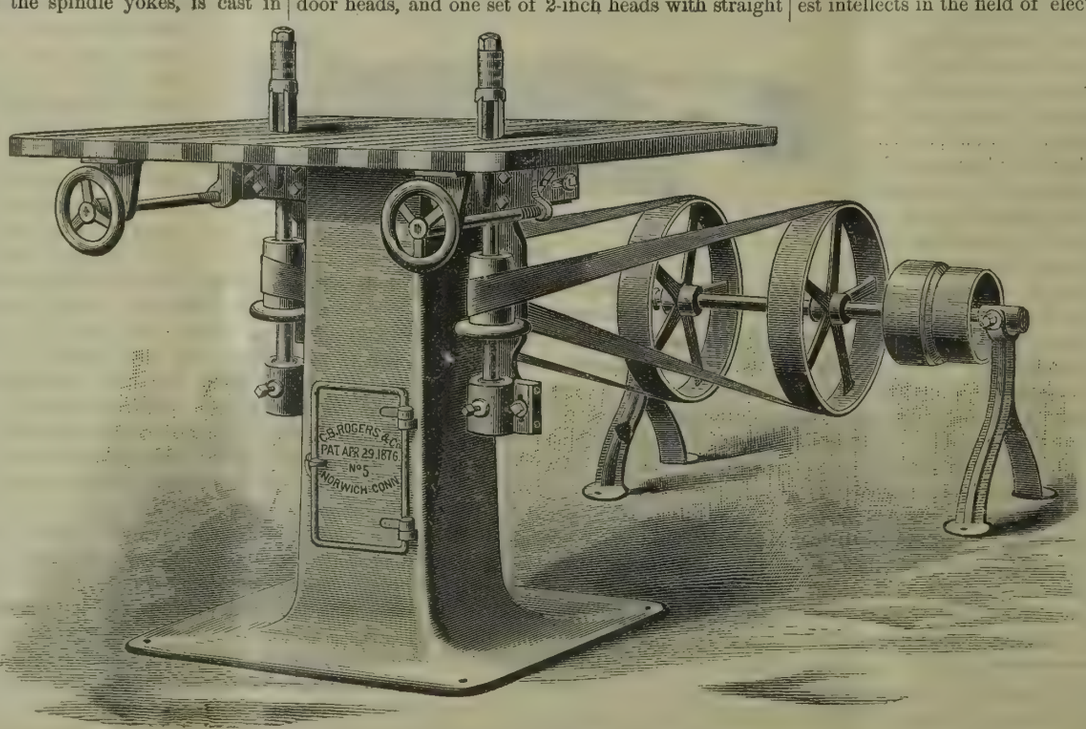


Fig. 2.—PEDESTAL SHAPING MACHINE.

Storage Batteries.

For many reasons, it may be regarded as good as settled that the future of the electric light for domestic purposes (that is, the so-called incandescent system), will depend very largely upon the substantial improvement of the storage battery.

We have from time to time referred to these devices in this journal, but for the convenience of those of our readers who may not have read our former statements, we will give a few brief definitions of their nature and action.

The storage battery is an apparatus in which electricity, generated in a galvanic battery, or by a dynamo-electric generator, may be stored up or accumulated, to be given out subsequently as it may be required. The convenience of such an arrangement, presupposing the facts of its economy and efficiency, is obvious. Every house of a district into which the electric light fixtures have been introduced, would then be independent of the central station for its power, being supplied at stated intervals with freshly charged storage batteries, to replace those that had run down. The central station would become, in this case, an establishment for charging and distributing the portable storage batteries to consumers of electricity at so much per foot-pound of stored energy.

The plan with which Mr. Edison's name is associated in this city, of distributing electric force from a central station by powerful dynamos sending their currents through a system of wires, is, in the present state of our knowledge, the only feasible plan for the purpose, as the best storage batteries which it is possible for us to construct, do not combine sufficient portability with efficiency to make them practicable. The keenest intellects in the field of electrical invention, however, are at work on the problem, and we are satisfied it will not be long before it is successfully solved.

The London *Engineering* lately contained the statement that the Faure accumulator (storage battery) had been reduced to 61 pounds per horse-power per hour. This is getting the device down to practicable form very rapidly; and if that rate of improvement is maintained, it will not be many years before it will be generally applied, not only to electric lighting, but also as a source of motive power for many uses.

A recent writer on

the subject does not doubt but that street cars, velocipedes, boats, carriages, etc., will soon be propelled by this means, and that the irregular power of windmills will be used to store electricity by day to light our dwellings by night. For our part, we do not doubt that there is a great field of future utility for the secondary battery, so soon as it has been improved sufficiently to meet all requirements.

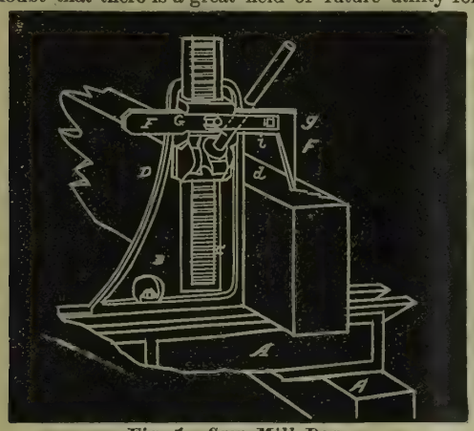


Fig. 1.—Saw-Mill Dog.

Recent Improvements in Wood-Working Machinery.

Fig. 1 represents a saw-mill dog invented and patented by James Little, of Evansville, Ind. The following points are claimed as novel: 1. The combination, with a rack bar and a sliding head provided with several bearings, of an operating lever having a shifting fulcrum to coöperate with the said bearings. 2. In a saw-mill dog, the combination, with a sliding head provided with several distinct bearings, of an operating lever, the fulcrum of which can be set in either of said bearings. 3. In a saw-mill dog, the combination, with a sliding head, of an operating lever provided with the rigid locking lug or projections engaging with said head to lock the lever. 4. In a saw-mill dog, the combination, with a sliding head provided with several bearings, of an operating lever adapted to be set in either of said bearings, and provided with a rigid locking lug or projection engaging with said head to lock the lever. 5. In a saw-mill dog, the combination, with a rack bar and a sliding head, of an operating lever having a segment gear to engage with said rack, and provided with the rigid locking lug or projection engaging with said head. 6. In a saw-mill dog, the combination, with a dog bar provided with a single hole and a stop or set pin, of a sliding head having a series of perforations to receive said pin. 7. In a saw-mill dog, the combination, with a sliding head having a series of perforations and a groove or channel connecting the same, of an adjustable dog bar provided with a single hole, a stop pin, and a retaining spring to hold said pin in place.

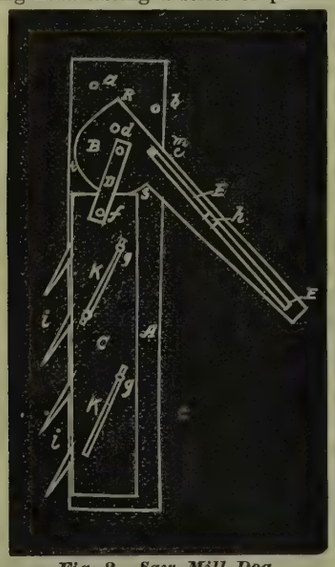


Fig. 2.—Saw-Mill Dog.

Fig. 2 illustrates a saw-mill dog invented and patented by Michael Shawyer, of Tremont, Ohio. The following points are claimed as novel: The combination, in saw-mill dogs, of the dog plate C, having the inclined slots *k k*, and the dog points *i i i i*, with the knee plate A, having the bolts *g g* and the holes *a b m*, and with the cam B, having the eccentric R *t s*, the fulcrum bolt *d*, and the spring latch E, provided with the pin *c*, and also with the connecting strap D.

Fig. 3 shows a guard for circular saws, invented and patented by Joseph G. Groff, of Connersville, Ind. The following points are claimed as novel: 1. The combination of the guard or hood having the shank and the upwardly inclined arm with the post having the guides for the guard shank to work in, and with the cord and counter-weight. 2. The combination of the guard or hood and its shank, of the posts and the guards thereon for the shank, with the cord and counter-weight and a locking device for securely holding the guard shank when raised. 3. The combination of the guard and its shank, the guides on the post in which the shank works, the off-set on the guard shank, and the stop bar against which the off-set strikes to limit the movement of the guard. 4. The combination of the shank carrying the saw hood, the square-headed bolt having the screw-threaded shank, with the hand-wheel having the beveled collar, and the plates coöperating with said collar to hold the hand-wheel at all times in the same relation to the post.

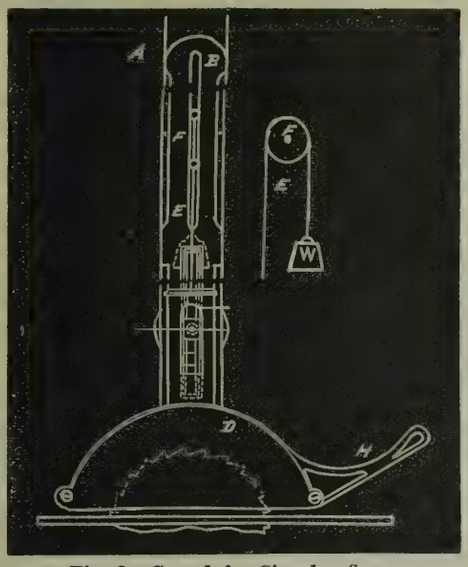


Fig. 3.—Guard for Circular Saws.

Fig. 4 represents a saw guard invented and patented by Henry F. Kuhlman, of Indianapolis, Ind. The following points are claimed as novel: 1. In a shield or protecting device for circular saws, the combination of the fixed hood G, extending over the top of the saw, and the movable guard H, hinged to the sides of the hood by parallel arms *h h*, and having a curved or beveled front H′, to adapt it to be shoved up into the overlapping hood by contact with, and the passage of, the plank to be sawed. 2. In a shield or protecting device for circular saws, the combination of the slotted saw table A, having plate C fastened to its under side, right-and left-handed screw D, sliding plate E, having the upright plate F projecting through the slotted saw table, and vertically adjustable hood G, having the movable guard H, and adjustable pivoted back-stop K.

Fig. 5 illustrates a device for straining scroll saws, invented and patented by Frederick H. Sweet, of Williamsport Pa. The following points are claimed as novel: The combination of a head stock, pendulous springs pivoted thereto, and a pair of floating or unpivoted rockers connected thereto, and supported by flexible straps connecting the free ends of the springs, and having arms flexibly connected to a saw.

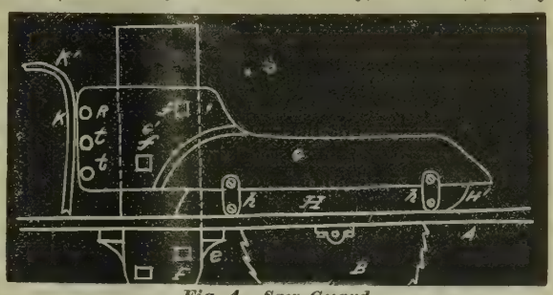


Fig. 4.—Saw Guard.

Test of the American Fire Shield.

An interesting experiment was made at the New York Navy Yard on Thursday, November 2d, by Mr. F. W. Sanborn, of No. 5 Barclay street, this city, of the American Fire Shield Co.'s asbestos cloth curtains and shields. This test was given under instructions of the Secretary of the Navy, to demonstrate their applicability for use in the navy yards as shields for buildings to protect them against fires or the heat of fires in close proximity, and also of vessels, to protect them against fire-ships or conflagrations in harbors, or to enable them to assist vessels on fire; also for use as magazine curtains, lining of magazines and shell rooms, lamp rooms, and as a general protection against fire in every form.

The experiment made consisted of hanging one of the pure asbestos cloth curtains, 18 feet square, from an iron frame, in front of which was three-quarters of a cord of dry pine wood set on end, the interstices filled with shavings, rosin and tar barrel staves, and the whole covered with half a barrel of coal tar and ten gallons of kerosene.

On the assembling of the Board of Naval Officers at 2 P.M., the fire was ignited, and instantly burst into a furious flame, giving forth intense heat and driving the spectators back some distance. The fire burned fiercely for three-quarters of an hour, beating directly against the curtain with the strong wind that was blowing. The embers were then extinguished, the curtain taken down and examined, and found to be not the least injured by the great heat to which it had been subjected, proving conclusively that the curtain was capable of withstanding the greatest degree of heat without injury. When the fire was burning at its utmost intensity, persons were able to stand within one foot of the curtain on the lee side, while in front persons could not approach within one hundred feet of the fire.

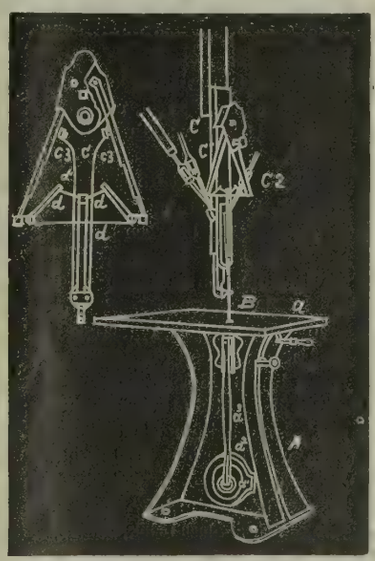


Fig. 5.—Device for Straining Scroll Saws.

The material has the appearance of heavy cotton

canvass is equally strong and pliable, and is woven 36 inches wide in strips 100 feet long. The curtain exhibited was composed of six of these strips 18 feet long, sewn together with asbestos thread.

This cloth can be used for curtains and scenery in theaters, being uninflammable and incombustible, and strong enough to resist the indraught of the fiercest fire. It is proposed to use it also as window curtains instead of iron shutters, arranging them under the cornice on the outside of the building so they can be dropped from the street, or by the melting of an easily fusible alloy.

For the protection of the iron fronts of the splendid buildings now being erected in this city in the narrow streets, which, if a fire occured on the opposite side, would be sure to expand or break, it is most valuable.

In small villages unprovided with fire apparatus, it would render the spread of flames to adjoining houses quite impossible. There is no doubt but that this material must come into use as an important agent in the protection of property and as insurance patrol covers.

We have had the pleasure of examining this cloth at the store of Mr. Sanborn, No. 5 Barclay street, who has the selling agency of the American Fire Shield Company, and who is now selling large quantities of the asbestos flooring felt and mill-board for the new apartment houses in course of erection.

Building Intelligence.

Architects, Builders and Contractors are invited to send us items of interest for this department. It is our object to notice only the more important operations in building, our space being too limited for the publication of minor matters, which, besides, possess only local import. We wish to publish only such intelligence as is of general interest.

New York City Building Items.

A Presbyterian church is to be built on One Hundred and Twenty-seventh street, west of Sixth avenue.

A row of six-story buildings, intended for warehouses, will be erected by Alfred Brady at Nos. 37, 39, 41 and 43 Greene street, at a cost of $150,000.

William Rankin is about to erect a five-story flat house, 25 feet by 90 feet 3½ inches, on the south side of Fifty-fifth street, 175 feet east of Tenth avenue.

Grace Church is building an extension in white marble facing on Fourth avenue. The architecture is somewhat in the style of the main building, but more ornate.

Findley & Gardner will build a four-story flat house at No. 431 West Forty-eighth street. It will be 25 by 68 feet by 100 feet 5 inches, with an extension 16 by 16 feet.

I. E. Wright proposes to erect a storage house, with flats above, 50 by 100 feet, on the south side of One Hundred and Twenty-sixth street, between Lexington and Third avenues.

Plans have been completed for a French-Canadian Catholic church, Gothic in architecture, to be erected in Seventy-sixth street, between Third and Lexington avenues.

John Taylor Johnston is having plans made for a seven-story bonded warehouse, which he intends to erect on Thirteenth avenue, extending from Twelfth to Bethune street, at a cost of $124,000.

Plans have been filed for a new Methodist Episcopal church, to be erected at Park avenue and Eighty-sixth street. The building is to be constructed of brown stone, with an ornamental front, and is to cost $70,000.

McKim, Mead & White have plans under way for the erection of a first-class brick, stone and terra-cotta apartment house, on the southwest corner of Fifth avenue and Forty-second street, by Jacob D. Taylor, of Jersey City.

G. Robinson, Jr., has designs for an apartment house, to be erected on the northwest corner of Third avenue and One hundred and Fifteenth street. It will be of unique design, 48 by 75 feet, five stories high, and cost $40,000.

J. G. Prague is making preparatory sketches for the handsomest private residence ever erected in Harlem. It will be built on the plot of ground on the southwest corner of Fifth avenue and One Hundred and Twenty-sixth street, 100 by 120 feet.

James Renwick is preparing designs for the erection of a white marble spire for Grace Protestant Episcopal Church, on the east side of Broadway, north of Tenth street. It will be 130 feet high, and will be surmounted by an illuminated cross.

The Cotton Exchange has purchased as a site for a new Exchange building Nos. 2, 2½, 4 and 6 William street; 58, 60 and 62 Beaver street; and 107, 109, 109½ and 111 Pearl street. Several of the leases do not expire until May 1st, 1884, so that there will probably be some delay in beginning to build.

Park & Tilford are about to build a large store on the east side of Fifth avenue, between Fifty-ninth and Sixtieth streets, at a cost of $110,000. It will be 50 feet front and 80 feet deep, and Baltimore brick, brown stone and terra-cotta will be used in its construction.

Anthony Pfund is drawing plans for a four-story brick brewery and storage house, 52 feet 8 inches by 119 feet, to be erected on the north side of One Hundred and Twenty-seventh street, between Ninth and Tenth avenues, at a cost of $28,000. The owner is D. G. Yuengling.

The Mutual Life Insurance Company are about to erect an extensive office building on the plot of ground formerly owned by the United States government, on Nassau street, and occupied by it as a post office; but as yet they have not decided on any definite plan nor as to what architect they will employ.

An imposing and costly church edifice is being erected at the corner of Madison avenue and Sixtieth street, by the congregation known as the Madison Avenue Methodist Episcopal Church. The church building, which, with the ground it stands upon, is to cost over a quarter of a million dollars, will be a large and commodious one.

A syndicate will erect a very extensive office building on the plot of ground known as Nos. 5, 7, 9 and 11 Broadway, and Nos. 5, 7, 9 and 11 Greenwich street, 162 feet 4 inches by 200 feet by 151 feet 10 inches by 170 feet 8 inches. The plans have not yet been determined upon, but will probably include accommodations for a new Stock Exchange.

A house of worship is being built by the congregation of the Pilgrim Congregational Church, at Madison avenue and One Hundred and Twenty-first street. The edifice will be of pressed Trenton brick, trimmed with Scotch granite. It will have a frontage of 75 feet on Madison avenue and extend 125 feet on One Hundred and Twenty-first street. The building will seat 750 persons. The chapel at the east end will contain a lecture-room. The estimated cost of the building is $50,000. It will be ready for occupancy about the first of December.

Thomas Osborne will soon commence the erection of an eight-story and basement apartment house, 54 by 96 by 104 feet, on the north side of Seventeenth street, commencing 281 feet 6 inches west of Second avenue. The front will be of English red stone elaborately carved and trimmed, while the interior will be fitted with the latest modern conveniences. Mr. Osborne proposes to have all the labor on this structure done by day's work, and will expend, including the cost of the ground, at least $165,000.

Robert A. Johnston, of the firm of J. & C. Johnston & Co., of Broadway and Twenty-second street, has recently purchased of the heirs of James E. Bettner a tract of land, comprising about twelve acres, at Riverdale, and bordering on the Hudson river, near Mount St. Vincent, and will at once build upon it a large and handsome house. The style will be Queen Anne and the material gray granite, with Scotch granite trimmings. It is expected to have the house ready for occupancy by June next. The total cost of the grounds and house will be about $150,000.

A novelty in the direction of apartment houses is about to be constructed on the site of the armory that formerly stood on Twenty-third street, between Seventh and Eighth avenues. That large and not very slightly structure was destroyed by fire in 1878, and the ground on which it stood has been lying waste ever since. The new building will greatly improve the appearance of the neighborhood, and will enhance the value of property there. Like half a dozen other large apartment houses that are now being erected, this is to be built on the coöperative plan, the capital invested being contributed by the tenants, who will hold stock in proportion to their respective investments. But in some respects the "Chelsea" will be unlike any other that has yet been planned. One novel feature will be the small size of many of the apartments, which will range from nine to three rooms each. Every apartment will, besides this, have a bath-room. Only the largest apartments will have kitchens or cooking facilities. The others will be supplied, if it is desired, by a caterer, who will have extensive equipments in the basement. He will also conduct a first class restaurant, so that the tenants can take their meals there, or have them sent to their rooms, as they prefer. It is thought that the smaller apartments will be in great demand for bachelors, and married people without children or servants At present the supply of such accommodations in the city is wholly inadequate, and at the same time extremely high-priced. The apartments will be connected by electric bells with the restaurant, and tenants can give their orders on rising and have breakfast waiting for them by the time they are dressed. The design is that the caterer shall be a thoroughly competent person, who will run an excellent restaurant at reasonable prices. There is also to be a housekeeper, with servants, who can be engaged by such of the tenants as desire it, to take entire care of their rooms. The first story is to be given up to stores. Above these there will be ten stories more, the highest of which is to be arranged in studios for artists, with sleeping and bath-rooms attached. Near the entrance there will be a ladies' parlor, where callers will wait while their cards are taken up in the elevators. The building is to be of brick, fire-proof throughout, and the entrance is to be finer, if the architects are correct in their view, than is possessed by any apartment house in the city. It is to be heated throughout by steam. The entire cost of land and building is estimated at $580,000.

Miscellaneous.

J. R. Thomas is at work on plans for a brick and stone chapel, to be built at Botetourt Springs, Va., by the Hollus Institute.

At Elberon, Long Branch, N. J., the cottagers have raised a fund of $40,000 for the erection of a casino. Plans are being drawn for the buildings, which will be put up this winter, on a beautiful plot of ground south of Elberon.

J. R. Thomas has designs in hand for a new church in the early decorative style, to be built at Lynchburg, Va. The exterior will be of pressed brick, trimmed with Richmond granite and terra-cotta, the dimensions being 98 by 125 feet, with a spire 200 feet high.

Babcock & McEvoy are drawing plans for the erection of a Protestant Episcopal church and chapel, to be known as St. John the Less, at Scarsdales, N. Y. It will be built on a portion of the Popham estate, the church being 30 by 82 feet, with a seating capacity of 250, while the chapel will be 18 by 26 feet. It is to cost $12,000.

H. G. Knapp has plans in hand for the following structures: A school-house, with accommodations for 800 scholars, to be built at Haverstraw, N. Y., at a cost of $11,000; a frame dwelling for George S. Allison, of Stony Point, N. Y., to cost $4,200; a brick cottage for Adam Glassing, of Haverstraw, and twin cottages for Charles Lane, of the same place, that will cost $3,500.

Lidgerwood Double-End Hoisting Engine.

The accompanying engraving represents one of the numerous forms of hoisting engines designed and manufactured by the Lidgerwood Manufacturing Co., of 96 Liberty street, this city, some of whose specialties have already been described in this journal. The engine here referred to is designed by its makers to be set between two derricks, so that they may be operated independently.

By consulting the engraving, the machine will be seen to consist of two separate engines, with drums and other appurtenances, all attached to one bed plate. The latter is a single casting, 5 feet wide and 10½ feet long. The boiler, which is of extra iron of first quality, is placed in the center of the bed plate. It is an upright tubular, 42 inches in diameter, 90 inches high, and has 88 tubes of 2 inches diameter. It is further provided with a reliable spring safety valve, a steam gauge, water glass and gauge cocks. It has likewise seven hand-hole plates, disposed in such a manner as to afford every facility for cleaning out dirt and scale. It is well secured to the frame by bolts and braces. The engines have cylinders 8½ ×10 inches, and have already been described in our previous articles on the Lidgerwood hoisting engines.

The two engines, placed on opposite sides of the boiler, are intended to be operated independently. The following details respecting them are of interest: Each engine has two drums, which have either plain or grooved faces, as desired. The mechanism for starting and stopping the drums is in the form of a friction clutch. The inner surface of the large gear, keyed to the shaft at the end of the drum, has wooden segments bolted upon it, with the grain of the wood running radially from the center. This wood is of the hardest kind, being well seasoned hickory. The inner ends of each block abutt against the hub, and the edges are neatly fitted together, so that when they are all in place they are practically equivalent to a solid wooden face. The outer ends of the blocks are beveled off to fit a recess of a similar shape in the end of the drum. As the drum is loose upon the shaft, it is moved endwise to and from the wooden face upon the gear, so that the friction is positive. The surfaces in contact being one of wood and the other of iron, the wear is very slight, and there is no tendency to heat and thus destroy the surfaces.

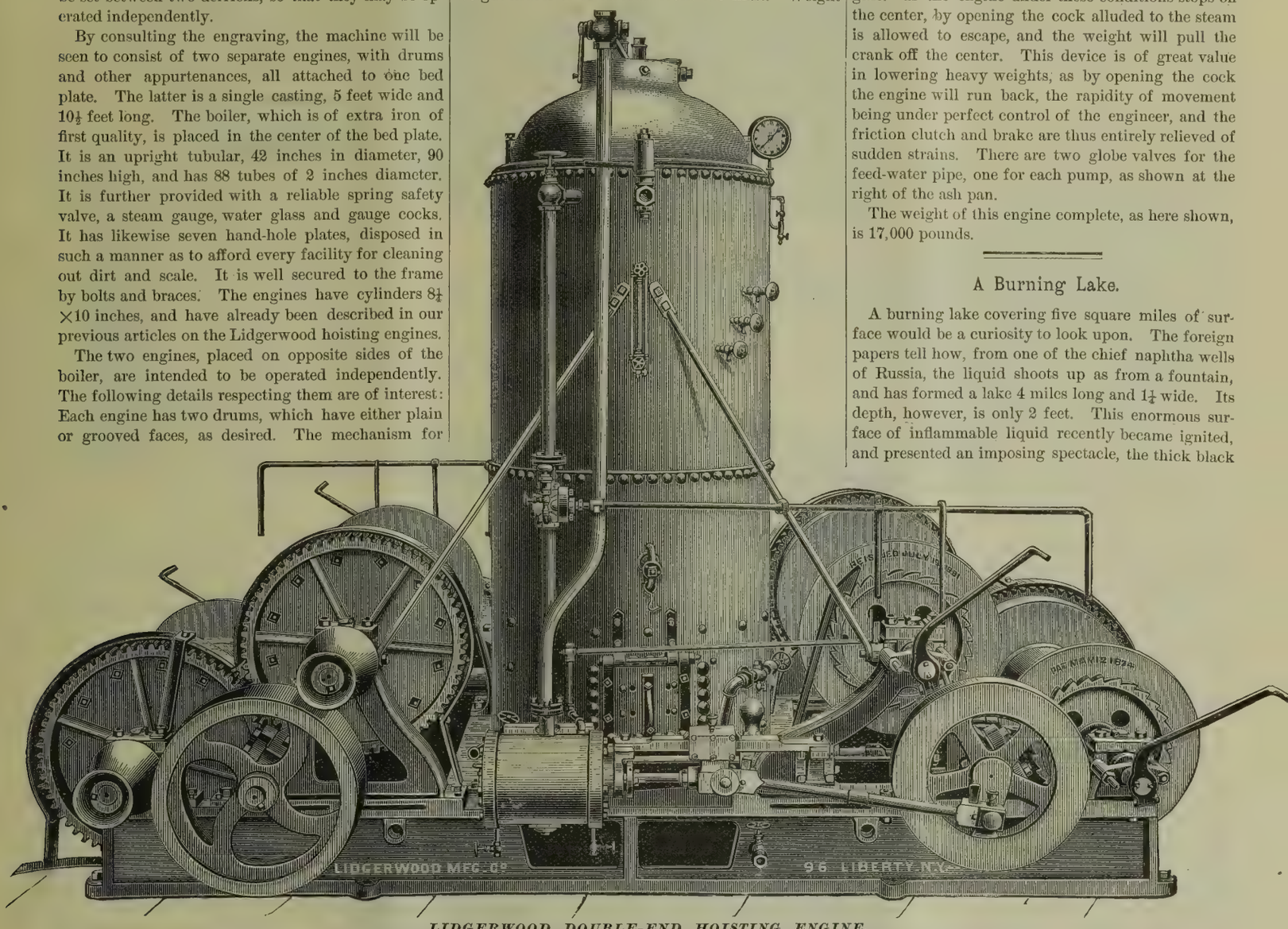
The mechanism for moving the drum endwise consists simply of a handle at the end of the shaft, within easy reach of the engineer, connected by a clamping device to a screw fitted through a cross-bar at the end of the shaft. This screw presses a steel pin in the end of the shaft, and communicates end motion to the shaft by means of a collar and cross-key. It will thus be understood how a very little pressure upon the handle will hold any weight that the engine is capable of hoisting. The surfaces of the friction clutch are proportioned to the size of the cylinder, and will last for many years, with good care.

When set between two derricks, as above remarked, the engines may be operated independently. The upper drum is used to hoist the weight, while the lower one raises and lowers the boom that carries the weight nearer to or farther from the mast. Weight or boom may be held in any desired position by throwing the catch into the ratchet seen at the end of the drum. The drums have a winch upon the ends of their shafts, to be used whenever desired, and which are of special service for hauling or moving stone or other heavy weights. A band wheel is provided on the end of the shaft of each engine, to drive rotary pumps or other machinery by applying a belt when desired.

The engines are not reversible, and when desired a foot brake may be attached to act upon the flange of the drum. This arrangement is preferred by some who still insist upon working in the old way, and to save the friction wheels where there is a great deal of lowering to be done. This engine can be handled with great ease, the throttle having two handles, as shown, so that the engineer, in handling either drum, can easily reach one of the handles for the throttle. Each engine has a feed-pump worked by an eccentric upon its shaft. These pumps are independent of each other, thus enabling the engineer to feed the boiler with either engine, or, in case one should fail when he has no time to repair it, the reserve pump can be called into requisition.

The exhaust pipe is provided with a three-way cock, so that the exhaust steam may be turned into the air or into the smoke stack, as required. A small pipe is tapped into the steam chest, having a plug cock at the end. This cock is operated by a handle within reach of the engineer, as shown. The object of this cock is to prevent the engine from stopping on the center, as, for example, in hoisting heavy weights which require nearly all the power of the engine. If the engine under these conditions stops on the center, by opening the cock alluded to the steam is allowed to escape, and the weight will pull the crank off the center. This device is of great value in lowering heavy weights, as by opening the cock the engine will run back, the rapidity of movement being under perfect control of the engineer, and the friction clutch and brake are thus entirely relieved of sudden strains. There are two globe valves for the feed-water pipe, one for each pump, as shown at the right of the ash pan.

The weight of this engine complete, as here shown, is 17,000 pounds.



LIDGERWOOD DOUBLE-END HOISTING ENGINE.

A Burning Lake.

A burning lake covering five square miles of surface would be a curiosity to look upon. The foreign papers tell how, from one of the chief naphtha wells of Russia, the liquid shoots up as from a fountain, and has formed a lake 4 miles long and 1¼ wide. Its depth, however, is only 2 feet. This enormous surface of inflammable liquid recently became ignited, and presented an imposing spectacle, the thick black clouds of smoke being lighted by the lurid glare of the central column of flame, which rose to a great hight. The smoke and heat were such as to render a nearer approach than one thousand yards' distance impracticable. Suitable means for extinguishing the fire were not at hand, and it was feared that the conflagration would spread underground in such a manner as to cause an explosion. This supposition led many of the inhabitants of the immediate vicinity to remove to a safer distance. The quantity of naphtha on fire was estimated at four and a half million cubic feet. The trees and buildings within three miles' distance were covered with thick soot, and this unpleasant deposit appeared on persons' clothes, and even on the food in the adjacent houses. Not only was the naphtha itself burning, but the earth which was saturated with it was also on fire, and ten large establishments, founded at great expense for the development of the trade in the article, were destroyed.

At the Milan Exhibition a "vino solido" was introduced. It was in the form of a paste, which, when dissolved in a glass of water, was said to yield instantly a generous wine of good appearance and bouquet.

Boiler Construction and Setting.

We illustrate and describe in the following article certain novel modifications in the construction and setting of steam boilers, which have been experimented upon by the Hartford Steam Boiler Inspection and Insurance Co., and found to be so satisfactory in practice as to meet with the warm recommendation of this enterprising company. A number of boilers containing the modifications in question have been constructed and set up under the supervision of the company, and the results obtained are said to have exceeded expectation. We append the following illustrated description with engravings, which we summarize from the monthly bulletin of the company :

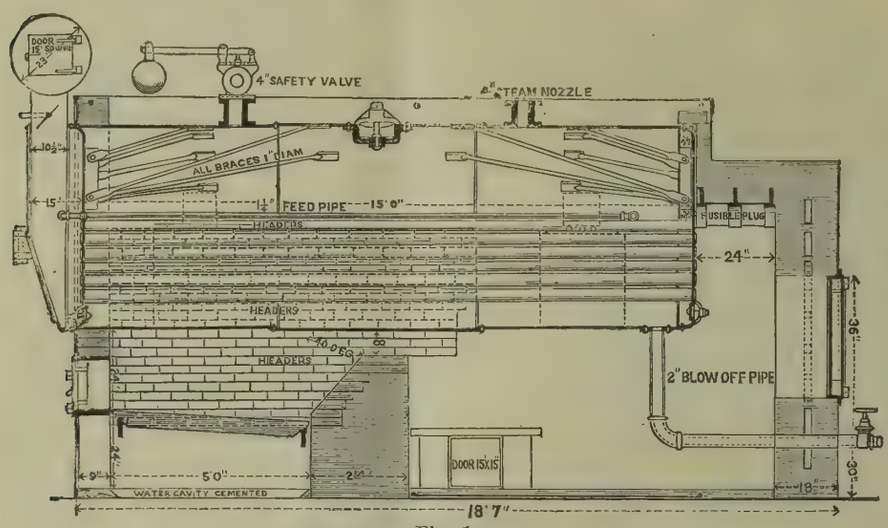


Fig. 1.

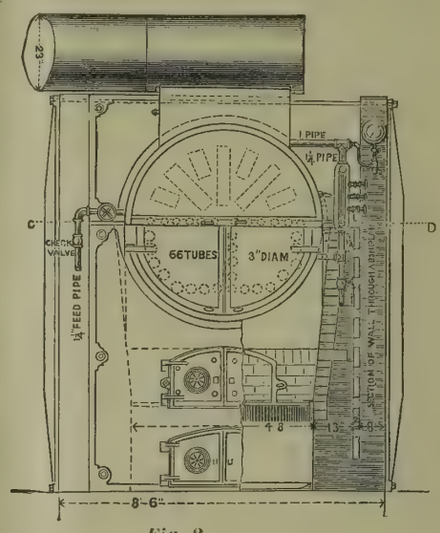


Fig. 2.

The boilers are of unusual dimensions, and to insure the best results the setting must be carefully done. In most cases chimneys have been planned with special reference and adaptation to them, so that they have not been recommended except where an entirely new boiler-house and chimney were to be erected. A more common size of boiler is 16 feet 3 inches long outside and 60 inches in diameter, containing 66 tubes, each 3 inches in diameter. The front of the boiler is what is what is known as the projecting cut-away front, as shown in Fig. 1. The tube heads are 15 feet apart ; tubes, 15 feet long. They are set in vertical and horizontal rows, with a broader central vertical space. The tubes are arranged to secure the best circulation of water. There are 20 braces in all—10 on each head. These braces are secured to pieces of T-iron placed radially on each head, as shown in Fig. 2. This method of securing braces is said to have proved advantageous for two reasons: The pull of the brace is straight from the web of the T-iron, a jaw being made on the end of the brace, which is pinned and keyed to the web; and second, the pieces of T-iron riveted to the head give it stiffness. The braces should be made of iron at least one inch in diameter, *with no weld.*

Every boiler should be supplied with two nozzles, one for steam and one for safety-valve. The practice of putting up a nest of boilers with only one safety valve is dangerous and pernicious. Every boiler should have its own independent safety-valve. It will be noticed in Fig. 1 that there is a door at the rear end of the setting 2 by 3 feet. This is important to facilitate cleaning the bottom of the boiler, and for removing ashes that may accumulate in the rear of the bridge wall. The man-hole should be put on the inside of the boiler shell. If well done, a more effective reinforcing of the strength of the man-hole is secured, as well as a tighter joint.

In preparing the foundations for the boiler settings great care should be taken to see that they are firm. Many boiler foundations are simply brick-work laid on the ground. When the boiler has been used a short time, the foundations settle and the walls crack and tumble down. Do the work well, even if it costs a little more to begin with; it will be economy in the end. The walls should be heavy, with air spaces in the center to prevent fractures from expansion and contraction.

Fig. 3 shows the plan of boiler and setting. The feed should be introduced through its own independent pipe, with suitable check and stop valves. It is not good practice to blow and feed through the same pipe. There are many details in the designing, construction and setting of boilers which must not be neglected if safety and economy are to be attained.

Tubes of greater diameter than 3 inches may be used with good results; all depends upon their proper arrangement.

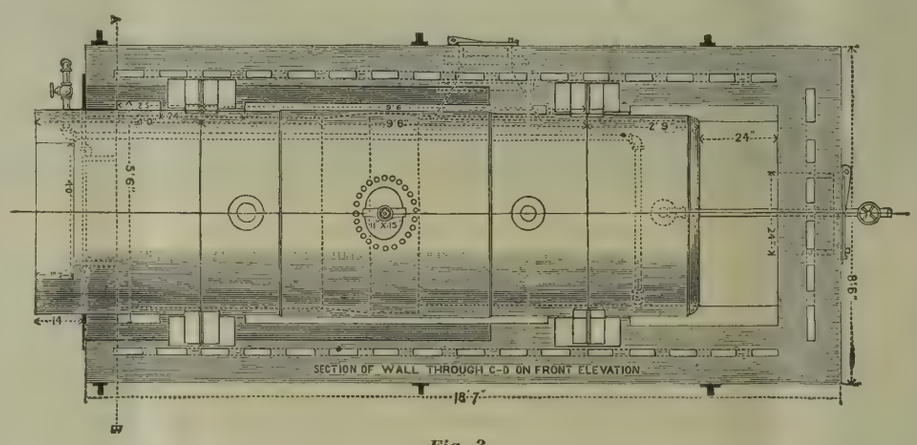


Fig. 3.

The Hartford company informs its patrons that it is prepared to furnish plans and specifications for both boilers and settings, and to supervise the settings if desired. It also prepares plans for boiler-houses and chimneys.

Driving Belts.

Prof. J. Bauschinger publishes the results of a series of tests of the tensile strength of different sorts of belting made in the Mechano-Technical Laboratory at Munich. In making a graphic representation of the results by setting the loads per square inch on a horizontal line, and erecting verticals corresponding to the elongations at the different loads, the curves thus obtained show considerable difference for leather, India rubber and cotton belts. All these materials stretch more at first, with light loads, than afterwards. The lines, therefore, are more curved at the beginning, and afterwards approach more to a straight line. But with leather belts the approximation to a straight line begins at once, and is more pronounced than with India rubber or cotton belts, showing that they stretch from the beginning more in proportion to the load, and possess a high degree of elasticity. The conclusions drawn from the tests by Prof. Bauschinger, is that India rubber and cotton belts are inferior to leather, not only as regards elasticity, but also as regards tensile strength, for the same section, and only attain in strength that of medium or inferior sorts of leather. By cementing and sewing the ends, leather straps lose one quarter to one-third of their strength, if the joints are made with great care.

Steam Press for Tool-Making.

A steam hammer or press has lately been invented, the rapid operation of which enables certain descriptions of tools or implements to be produced at a much less cost than heretofore. The weight of the machine is some thirteen tons, and, in its operation, dies are used according to the shape of the tool desired. In these dies a piece of iron of the proper weight is put, and by intense pressure the metal is fashioned to the desired shape. By an ingenious arrangement, the iron is "steeled"—that is, the required portion of steel is welded to it by pressure from four directions, when it is again placed in the die, repressed, and the "eye" punched; it is then taken to be pointed and dressed ready for the market. The capacity of the machine is rated at twenty-four dozen hatchets per week; a workman, by the ordinary method, could not turn out more than ten dozen in the same length of time. It is also applied to the cutting of iron, its rapid and effective action insuring a considerable saving of time and labor. In this latter operation a heavy knife is put upon the machine, and it will make a clean cut of two and a quarter by one and a half inches through cold iron.

THE WASTE OF WILD COCOONS gathered in the woods of China, Japan and Australia is made into a felt one-half the size of hair felt, and is used for the manufacture of hats, and for furnishing purposes. It has the peculiar bright color of silk, and it is sometimes used with hair, wool, cotton and other substances.

Proportions of Riveted Joints.

[*Continued from page 227, October Number.*]

Continuing the subject of the proportions of riveted joints from the *Locomotive*, published by the Hartford Steam Boiler Inspection and Insurance Co., we confine ourselves in this article to single riveted joints.

Fig. 17.—⅜-inch plate, single riveted; rivet holes, $^{13}/_{16}$ inch diameter; pitch of rivets=2½ inches. Strength of plate at joint=

$$\frac{2.125-.8125}{2.125}=62 \text{ per cent of solid plate.}$$

$$\text{Strength of rivets at joint}=\frac{.51849}{2.125\times.375}=65$$

per cent of solid plate.

Fig. 18.—$^{7}/_{16}$-inch plate, single riveted; rivet holes, ⅞ inch diameter; pitch of rivets=$2^{3}/_{16}$ inches. Strength of plate at joint=

$$\frac{2.1875-.875}{2.1875}=60 \text{ per cent of solid plate.}$$

$$\text{Strength of rivets at joint}=\frac{.60132}{2.1875\times.4375}=63 \text{ per cent}$$

of solid plate.

Fig. 19.—½-inch plate, single riveted; rivet holes, $^{15}/_{16}$ inch diameter; pitch of rivets = 2¼ inches.

$$\text{Strength of plate at joint}=\frac{2.25-.9375}{2.25}=58 \text{ per}$$

cent of solid plate. Strength of rivets at joint=

$$\frac{.69029}{2.25\times.5}=61 \text{ of solid plate.}$$

Danger of Public Steam Supply.

The *American Architect*, of Boston, relates the following: "An illustration of the possible dangers of the system of public steam supply, which is now rapidly coming into vogue, is furnished by an accident occurring lately at Lynn, Mass. In that town steam has been supplied for some time to customers by means of pipes laid in the streets, and one morning one of the street mains blew up with a loud explosion, hurling stones and gravel in every direction to a distance of forty or fifty feet. Nearly every window was broken in the neighboring building, and some of these received other injuries, while a woman who happened to be passing by was seriously hurt. The accident is explained by the daily papers, in their usually satisfactory manner, as having been due 'to accumulation of water in the pipes.' It seems this is the third explosion of the same kind which has taken place in Lynn within two weeks. After the first one an engineer was discharged, on the ground that his carelessness in 'allowing water to stand in the pipes' had caused the accident; but he appears to deny his guilt, and says that 'the system of pipe-laying is not correct.' If we were not afraid of hurting the feelings of the Citizens' Steam Company, we should say that both these explanations were simply ridiculous, and that the obvious cause of the explosion was the inability of the pipes to resist the strain upon them. Whose fault this may have been we do not care to inquire, but we may suggest that it would not be very difficult to ascertain in case of need. Meanwhile, we trust that the engineers of the new steam-heating companies in other cities are laying pipes which they are sure will not burst out of resentment at being improperly laid, or because of water being allowed to stand in them. An explosion in Broadway, New York, for instance, would be a serious matter, even if it amounted only to the hurling of a few hundred paving stones over the passers-by or through the plate-glass show-windows which line the street. But while we hope that the Broadway steam pipes may be stout enough to do their work for many years to come, the worst catastrophe that a defect in them could occasion, would be insignificant in comparison with the explosion of a main pipe in the Prall system of distribution of superheated water, which was once discussed in New York, but seems now to be happily abandoned. Remembering that a given body of steam at a pressure of 150 pounds to the square inch would expand, on being set free, only to five or six times its previous bulk, while an equal body of water under the pressure proposed in the Prall system, would expand at the instant of the breaking of a pipe to at least five thousand times its original volume, the comparative violence of the two kinds of explosion will be sufficiently manifest. Even the firing of an equal bulk of gunpowder would produce less effect than the sudden setting free of a column of water heated to 400° Fah.; and if the bursting of an ordinary steam main is sufficient to throw the stones and earth of the street above it through the topmost windows of the abutting houses, that of a hot-water pipe of equal capacity would not leave a building standing along the line of its course."

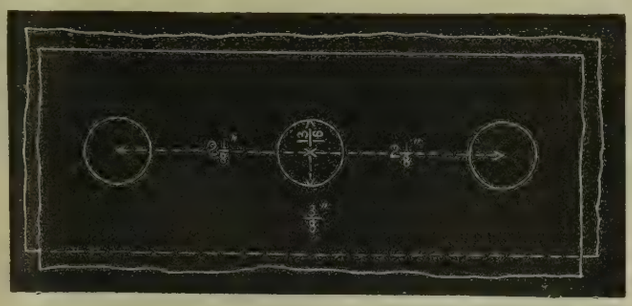


Fig. 17.

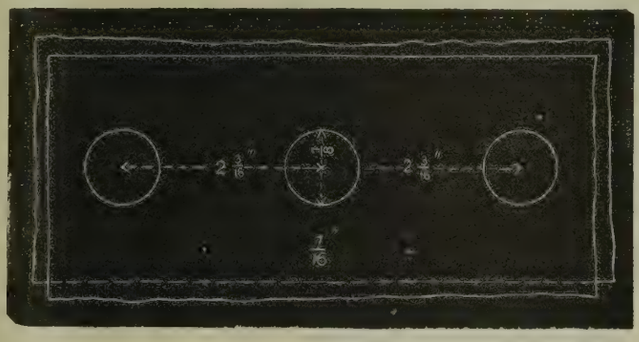


Fig. 18.

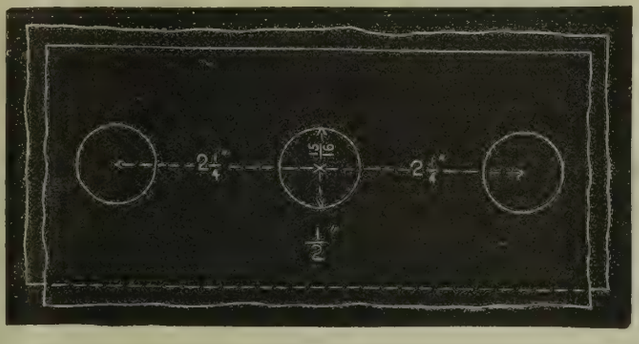


Fig. 19.

Statistics Relating to the New York and Brooklyn Bridge.

The East River bridge is slowly nearing completion. The bridge was commenced in January, 1870, and its cost up to the present time has been about $14,000,000. Probably $1,500,000 more will have to be expended to complete it. The New York tower contains 46,945 cubic yards of masonry, weighs about 124,000 tons, and its foundation is 78 feet below high water. The Brooklyn tower contains 38,214 cubic yards of masonry, weighs about 93,079 tons, and its foundation is 45 feet below high water. Both towers measure 140 feet in width by 59 feet in depth at high water line. Each tower is 278 feet above high water; hight of towers from high water to roadway, 119 feet; hight of towers above roadway, 159 feet; hight of center of river span above high water, 135 feet. The 21,184 wires composing the four cables, joined end to end, would cover a distance of over 14,357 miles. The promenade for foot passengers is placed in the center of the bridge, with the railroad tracks next to it on either side, and the wagon roadways further beyond, next the sides of the great span. This promenade will be 9 feet higher than the other thoroughfares, and the view of the river and the two cities from this part of the bridge will be very fine. It is intended that the bridge shall be lighted at night by electric lights. The grade of the roadway is 3¼ feet in every 100; anchorages at base, 119 by 129 feet; hight of anchorages in front, 89 feet; in rear, 85 feet; weight of each anchor plate, 23 tons; main span of bridge, 1,595 feet 6 inches; each land span, anchorage to tower, 930 feet; Brooklyn approach to bridge, 971 feet; New York approach to bridge, 1,562 feet 6 inches; total length of bridge, 5,989 feet; width of bridge, 85 feet; width of promenade for foot passengers, 15 feet 7 inches; width for railway on each side, 12 feet 8 inches; width for carriage-way on each side, 18 feet 9 inches. The first wire was run out May 29, 1877; cable-making really began June 11, 1877; number of cables supporting bridge, 4; diameter of each cable, 15¾ inches. Each cable contains 5,296 parallel steel wires; each single wire in the cables is 3,578 feet in length; weight of wires in each cable, 1,732,086 pounds; strength of each cable, 24,621,780 pounds; total strength of the four cables, 108,487,120 pounds, or 54,243 tons; permanent weight of bridge from anchorage to anchorage, 14,680 tons; transitory load on bridge (estimated), 3,100 tons; total weight to be supported, 17,780 tons.

The Signal Service and its Methods.

[*Continued from page 208, September Number.*]

Cautionary Signals.—The "cautionary signal," which is a red flag with black square in the center by day, or a red light by night, calls for caution in view of an approaching storm, and applies to winds coming from any direction. This signal is shown in Fig. 13, on the next page.

The "cautionary off-shore signal, and cautionary northwest signal," is cautionary against rough weather, and against winds expected to be in a northern or western direction, or "off-shore." This signal is shown in Fig. 14, and consists of a white flag with a black square in the center, shown above a red flag with a black square by day, or a white light shown above a red light by night. It is "cautionary" with reference to winds expected to blow from a northern or western direction, or off-shore, at or near the place at which it may be displayed.

The following directions are given with reference to the display of these signals: The cautionary off-shore signal will be displayed at and on the regular place and staff, and will consist of a white flag with a square black center, shown above a red flag with a square black center by day, or a white light shown above a red light by night. This signal will be known as the "cautionary off-shore signal," and will indicate, when shown, that while the storm disturbance is considered, at the office of the chief signal officer, as not yet passed for the port or place at which the signal is displayed, and the winds may yet be high,

and there may be danger, the winds are expected to blow from a northern or western direction, or off shore, at or near the port or place where the signal may be. The display of this signal will often follow, and must be distinguished from, the display of the usual cautionary signal—that is, a square red flag with a square black center by day, or a red light shown at night, which retains, whenever shown alone, its usual meaning. The display of either signal is always cautionary.

An additional cautionary storm signal will be displayed, as occasion may require, at all active signal and display stations of the signal service on the lakes. This signal will be known as the "cautionary northwest signal," and will indicate, when shown, that at the port or place where displayed it is anticipated that the winds will be dangerous and will blow from the north or west, or from a direction between those points. The display of this signal will generally follow, and must be distinguished from, the display of the usual cautionary signal—that is, a red flag with a black square in the center by day, or a red light shown at night, which retains, whenever shown, its usual meaning. The display of either signal is always cautionary.

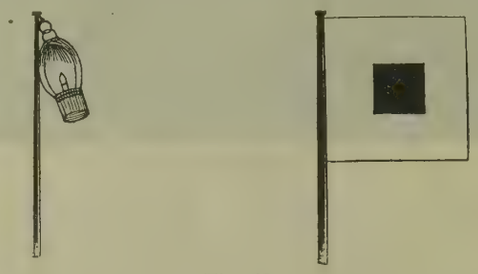


Fig. 13.

The cautionary northwest signal—that is, a white flag with a black square in the center, shown above a red flag with a black square in the center, by day, or a white light shown above a red light by night, will indicate, when shown, that the storm disturbance is not considered as yet passed for the port or place where it is displayed, and that the winds may yet be high, and the signal is cautionary with reference to winds expected to blow from the north or west, or from a direction between those points, at or near the place at which it may be displayed.

The order to display signals is accompanied with a brief message giving the location and probable movement of storm-center, the direction and anticipated changes in the direction and force of the wind in the lake region, and, when practicable, for each lake. The observers in charge of signal stations on the lakes, as well as all displaymen, must bulletin the order to display signals as well as the accompanying message, and any succeeding explanatory message, at such points as will secure the greatest publicity to the shipping interests, and must take any other steps that will insure the greatest distribution to the parties interested in this information. "Signals down" lowers any or all signals.

Stations ordered to display cautionary, cautionary off-shore, or cautionary northwest signals, are supplied with two (or more) red flags, one six feet and the other eight feet square, having square black centers one-third the size of the flag, and the same number of white flags with black centers; one red and one white signal lantern; one large flag staff; and two sets of small staves for use in cases of emergency. The large flag staff must be from 25 to 30 feet or more in hight, and so situated as to be clearly visible to as large a part as possible of the harbor and shipping it is designed to warn of approaching danger. The staff must be provided with halliards for raising and lowering the flags and lanterns, and must usually be erected on the roof of some building, preferably on the one in which the office is located, unless a more desirable position is found near the office.

In displaying two flags, one above the other in a hoist as a signal, a distance of at least two feet more than the length of the upper flag must be kept between the lower edge of that flag and the upper edge of the lower one; thus, with four-foot flags the distance must be at least six feet clear between the flags. In showing two lights as a signal, a distance of at least six feet clear must be kept between the upper and the lower light. If lanterns or lights, shown as signals, swing in such a way as to endanger breaking, the lower light or lantern may be stayed with a small but strong line. When one signal is to be lowered and another displayed, it may often be convenient to have the new signal already attached to the clear end of the halliards on which the signal displayed is flying, in such a way that as one signal comes down the other signal, complete, will go up.

Everything connected with the signal apparatus must be kept in perfect order; flags mended when torn, ties sewed on, halliards renewed, lanterns kept constantly filled and trimmed, and the approaches to the staff convenient, so that there may be no delay in obeying all orders to hoist or lower signals. Timely requisition must be made upon the central office for new articles of equipment before those in use become unserviceable.

Signals are ordered up by telegram from the central office in the words "up signals," "hoist off-shore signals," "hoist northwest signals," and will be ordered down in the words "signals down," which lowers any or all signals that may be up. Signals

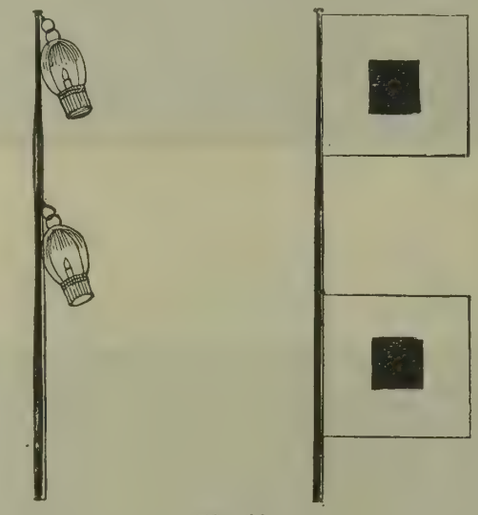


Fig. 14.

must remain displayed until the order to lower them is received from the central office, unless telegraphic communication with the office is interrupted and continues so for some hours after the storm has passed, in which case the signal must be lowered when the danger is over. Extreme caution must be exercised in this respect not to mistake the customary lull in the center of a storm for an indication that it has passed over the station. If the off-shore signal is displayed, and the wind at the time of the receipt of the order "signals down" has a velocity of twenty-five miles or more per hour, the signal must be kept displayed, and the velocity of the wind must be ascertained from the self-register at least once in each hour. As soon as the velocity has fallen below twenty-five miles in any one hour, the signal must be lowered.

Observers are not permitted under any circumstances to hoist or display storm signals without authority from the central office. They are also required to immediately acknowledge by telegraph the receipt of signal orders, either "up" or "down," with the name of the station, the nature of the order, and the time of receipt.

Display Stations are those designated for the display of cautionary off-shore signals when on the seacoast, and cautionary northwest signals when on the lakes, and are in charge of civilians employed for the purpose. They are usually grouped in sections, each section being under the supervision of a sargeant in charge of a signal service station. Those in charge of the display stations receive their instructions from, and acknowledge all orders to, the sargeant in charge by telegraph.

When there are no instruments at the station for determining the velocity of the wind, its force is to be estimated according to the following signal service scale:

0	Calm.
1 to 2 miles per hour	Light wind.
3 to 5 " "	Gentle.
6 to 14 " "	Fresh.
15 to 24 " "	Brisk.
25 to 39 " "	High.
40 to 59 " "	Gale.
60 to 79 " "	Storm.
80 miles per hour and above	Hurricane.

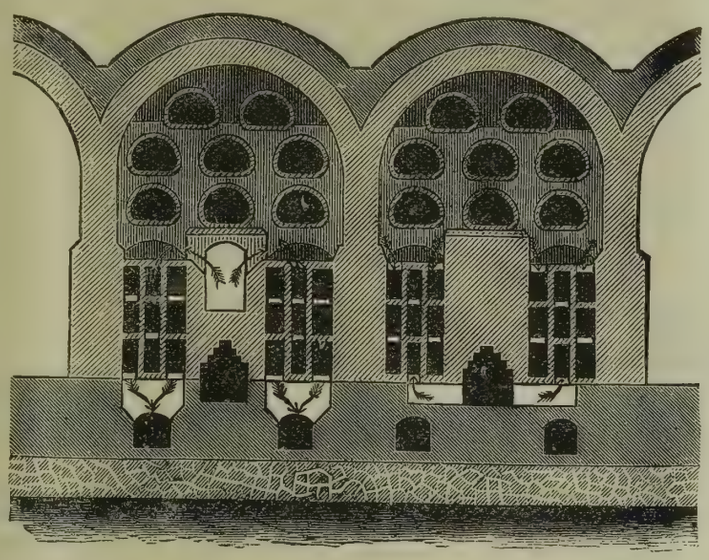
It must be recorded on the proper form in the following manner: No perceptible wind, "calm;" wind blowing with a velocity of from 1 to 2 miles per hour, "light;" wind blowing with a velocity of from 3 to 5 miles per hour, "gentle," etc. The direction from which the wind is blowing must be designated by the eight principal points of the compass—N., NE., E., SE., S., SW., W., NW. As soon as practical after a cautionary signal has been lowered at any station, the observer (or displayman) is required to collect from mariners and other data in reference to benefits, etc., derived from its display, the nature and violence of storms and disasters occurring therefrom, and must report the same, together with any comments thereon that may have appeared in the public newspapers, to the central office by letter. The sources from which information is obtained must always be stated. When the signal has not been justified, the fact must be stated. If, however, any storm has occurred in the vicinity of the station during the display, the same must be reported. A look-out must be kept at all seacoast and lake stations for wrecks during storms, and their occurrence must be reported to the central office by telegraph, without delay. In making the report the following information must be given as accurately as possible: Name and rig of vessel, name of captain, character of vessel (whether passenger or freight), number of passengers, place where vessel is ashore, port from which sailed and port to which bound, and what assistance, if any, is needed. In case assistance is not required, the fact is to be stated in the telegram. In case of loss of life, the names of the lost and the names of those saved are required to be telegraphed to the central office without delay. In making the report care must be had not to confound rumors with facts. The observer is required to report only what he *knows*, and what he has obtained from reliable sources.

PEROXIDE OF HYDROGEN, discovered by Thenard in 1818, is obtained by the action of sulphuric or hydrochloric acid on the binoxide of barium, and it is only during the last few years that it has been prepared commercially under sufficiently favorable conditions to come into general use. Its properties render it especially suitable for the bleaching of animal substances, such as wool, feathers, ivory, etc. The objects to be bleached must first, however, be freed from grease and other impurities to obtain a satisfactory result.

Dr. Siemens' Regenerative Furnaces Adapted for Gas Works.

By courtesy of Messrs. Richmond & Potts, the American agents of Dr. Siemens (119 South Fourth street, Philadelphia), we are able to lay before our readers the following facts respecting the adaptation of his regenerative furnaces to gas works, which is now attracting some attention in England:

The introduction of electricity for the production of light has rendered it more than ever necessary that gas supplied for that purpose, whether by local authorities or private companies, should, as to its cost, purity and light-giving power, be produced so as to compete on the most favorable terms possible in order to legitimately protect the vast interests which are already involved, and supply the public with light at the cheapest rate. To attain this object it is evident that every available means for facilitating the production, reducing the cost, and improving the quality and light-giving power of gas should be adopted, especially at a crisis when various systems of lighting by electricity are being brought under public notice, and the merits of gas, as compared with electricity, must be determined.



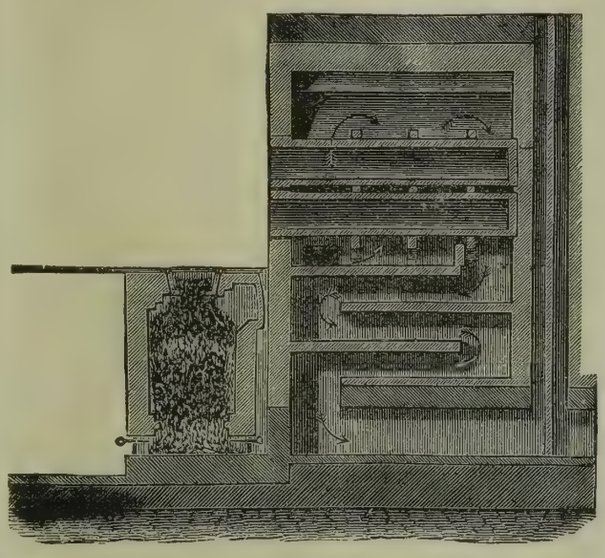
An additional reason for seriously considering this question, is that gas, as a heat-producing agent, will doubtless enter into competition with steam for the purpose of generating the electricity proposed to be used for lighting purposes; and if gas, owing to its present cost, be not able to compete successfully with steam, it will of course be excluded from participating in the advantages otherwise obtainable from its employment in this new sphere of usefulness.

It is important to mention that the more profitable application of gas as a means of generating electricity than as a light producer, by combustion in the present form, has been pointed out by electricians, and latterly more distinctly by Mr. Preece, F.R.S., in a lecture delivered at the Society of Arts, London, on the Paris Electrical Exhibition. But whatever the result may be as to the use of electricity as a light-giving agent, or the use of gas for the production of electricity or of light, it does not lessen the necessity of using every available means for producing gas at the most economical rate. It is with the object of advancing towards this end that attention is directed to Dr. Siemens' method of heating by means of his regenerative furnace. This furnace is constructed so as to utilize the waste heat, which in the ordinary furnaces is allowed to escape up the chimney, and to transfer it to the combustion chamber, by which means a considerable saving in fuel is effected.

The Siemens' furnace has been in use for many years in glass, steel and other works where great heat is required. There are now more than 10,000 at work, and the system is consequently fully proved—indeed it would be impossible to carry on some operations at all without its aid. As to the economy realized, it will be sufficient to say that in some operations the coal used for fuel has been reduced from three tons to one ton per ton of material melted, and in others from two to twelve hundred weight. It will be evident that, by the adoption of this system of heating where the consumption of fuel is great, the saving must be great also. The Siemens furnaces have been extensively adopted at the Paris gas works for many years, and in 1879 that company had applied them to 2,912 single retorts, admitting a saving by their use amounting to $109,200 per annum, and since that date this application has been largely increased.

In the Siemens furnace, as is well known, regenerators are employed, and the solid fuel is converted into a crude gas before combustion. Dr. Siemens' recent efforts have been directed to simplifying his furnaces and making them more applicable for heating gas retorts. These improvements are secured under two patents, dated 1880 and 1881.

When great heat is requisite, as in the case of melting glass or steel, it is found necessary to use the waste heat for the purpose of raising the temperature of the gas as well as of the air before they enter into combustion in the furnace, and the flow of both gas and air is from time to time changed by reversing valves requiring intelligent workmen. The heat required in gas retort furnaces, however, is so much less that it is found that the valves may be dispensed with and the flow of gas and air made continuous in one direction. By this means skilled labor is dispensed with, as the workmen have only to attend to the supply of fuel, which, being used hot as it is drawn from the retort, saves labor and loss of heat caused by slacking.



Dr. Siemens' furnace, or gas producer, as it is termed, is placed outside the oven instead of inside, as it is in ordinary furnaces, and the removal of the present furnace leaves space, in many cases, for the introduction of one or more additional retorts; consequently there is a considerable saving in the construction of retort house, building, land, etc. It is also found that the heat obtained is so much greater and more regular, that, in some cases, gas is produced with three-hour charges instead of four or six, thus increasing the power of production of a retort house from 25 to 50 per cent. Under these circumstances, it might fairly be said that the structural cost of the retort house with Siemens' furnace will be less on the ton of coal carbonized than it is now, this advantage being secured in addition to the other improved results.

The general advantages realized by the application of Dr. Siemens' method of heating may be summed up as follows: The use of 3½ cwt. of coke, for fuel, per ton of coals carbonized, and in some cases less; greatly increased duration of retorts and furnaces; shorter charges (say 3 hours, instead of 4 or 6 hours); reduction of labor; the prevention of leakage of gas from the retorts; increase in quantity and quality of gas produced per ton of coal.

At the last general annual meeting of the Gas Institute, W. Foulis, of Glasgow, made the following statements respecting the experience he had had with regard to regenerator furnaces. About eighteen months ago he had erected four furnaces of eight retorts each on Dr. Siemens' plan, carrying out his principle in its entirety. The arches were 8 feet 6 inches, and there were eight single retorts 18 inches by 13 inches by 9 feet, set back to back. Each setting had its own producer. Of course, as in all new things, there was a great deal of difficulty at first; but after working for some time, and often being disheartened, they had now got it into successful operation with very good results. The fuel they used was made entirely from Scotch cannel, and was very inferior; but notwithstanding this they were able to produce almost any heat they wanted. Their fuel account, although not a matter of very great interest to them—as the coke was so inferior that it was difficult to sell—had been reduced by two-fifths, and the amount of coal carbonized had been increased from 14 cwt. per retort in 24 hours to 17 and 18 cwt. They had worked off as much as one ton, and he hoped by-and-by to be able to manipulate a ton of coal every twenty-four hours. They made 9,800 or 10,000 cubic feet per ton, which was a large make considering the quality of coal used. One great advantage was the increased durability of the retorts from the regularity of the heats, and the absence of dirt on the outside of the retorts. The heats were steady from one week to the other, and were easily kept up. The retorts and the whole setting remained perfectly clean.

The accompanying illustrations are sectional views representing the arrangement adopted. The producer was a cylinder of brick-work 3 feet in diameter and 6 feet 6 inches high, encased in sheet iron. There were not any fire bars, the coke resting upon the brick-work at the bottom of the cylinder or pit. Round the bottom of the producer there were a few holes about 6 inches high and about 1 foot long, just sufficient to get the clinker out. The gas was carried from the producer through a flue, and entered the retort-setting underneath the side retorts, where it met the air coming from the regenerator. It entered the setting, not by a number of small openings, but by one large opening on each side, and met the air entering also by a large opening, the effect of which was to avoid the localization of intense heat. The flame was carried in a body over the whole setting, and the retorts were equally heated from end to end and from top to bottom. The generator consisted simply of a series of zigzag flues. The waste gases were carried down through the flues on each side of the air passage, and the air, entering first into a large chamber in the center, passed through the flue in the center of the regenerator, and by the time it entered the setting it was nearly red hot. The producers were very easily worked, being only filled once in six hours. The cover of the producer was lifted just

before the necessary number of retorts were drawn into the producer; the cover was then put on, and the remainder of the retorts were drawn, and nothing more was done for the next six hours. The men went down perhaps once in three hours to remove the ash. Altogether it was very successful, and they were going to extend the system. Some remarks had been made about the question of steam. They found that steam was a great advantage. Not only did it yield a better gas, giving hydrogen instead of large volumes of nitrogen, but there was also this advantage—the coke used contained sometimes as much as 15 or 20 per cent of ash, and at first they had much trouble with clinker; but by using steam this was brought down in the shape of fine ash, and gave no trouble at all. The ash was removed from below, and the men had scarcely ever to touch the clinker or ash from above. So far as his experience went, he was quite certain that great advantage would be reaped by the introduction of this system of firing.

A Fatal Accident with Electric Light Wires.—The daily papers of October 5th recorded, what we believe to be the first fatal accident with electric light wires in this city, though such fatalities have been occasionally reported from other localities.

The subject of this unfortunate occurrence was in the employ of the Brush Electric Light Co., and is described as an experienced line-man. He was engaged at the time of the accident which caused his almost instant death, in the work of lengthening a wire which was conveying a current of electricity, so as to enable it to be transferred to another and higher post. To splice a live wire is a work attended with so much hazard that we question if, were the real danger known, an insurance company would care to take a risk on the life of a man engaged in it at 100 cents on the dollar; yet from what we can learn from the published accounts, it appears to be a risk which the employés of this and the other electric light companies are habitually called upon to undertake.

The rule laid down for performing this hazardous operation, which is expected to be performed without interrupting the current, is to make a loop with the fresh wire around the point to be cut. To do this, the insulating material of the wire must be scraped away, that the joints may be made with the naked wires. One connection should be made before beginning another, and both connections should be properly made before cutting out the old piece of wire. The extreme danger of performing such a task will be understood from the fact that, should the hands, or any portion of the body, touch the wires while the work is being done, a portion or the whole of the electric current may pass through the body with fatal consequences. This is precisely what happened in the case here narrated, though just how the fatality occurred will never be known, for the man was unconscious when he was discovered, caught by the wires in such a manner that he did not fall to the ground, and he died shortly after being taken down. The palms of both hands where he had grasped the severed portions of the wires, probably to avoid falling, and thus completed the circuit through his body, were seared as though they had grasped red-hot iron.

This occurrence demonstrates in the most forcible manner that the splicing of wires while carrying the current, is altogether too hazardous an operation to be undertaken. The electric lighting companies will doubtless prohibit it in the future.

A Substitute for Celluloid.—Mr. Edward Weston, of Newark, N. J., has lately patented a procedure for producing a new plastic material, adapted to the same uses as celluloid, by a modification of the procedure employed in the manufacture of this well-known substance.

The standing objection to celluloid, as most of our readers are doubtless aware, resides in the fact of its great inflammability. It is not, as many suppose, spontaneously inflammable, or explosive, but will readily ignite on the approach of a lighted object.

The object of Mr. Weston appears to have been to produce a plastic material having all the essential qualities of celluloid that adapt it so admirably to furnish a substitute for ivory, horn, etc., without the disadvantage of being inflammable. This he proposes to do in the following manner: He treats cellulose, cotton, cotton waste, linen or paper, with a mixture of sulphuric and nitric acid of the requisite strength, and for the required time, to convert it into the soluble form of pyroxylene (gun-cotton). This product he converts either into collodion by dissolving in a mixture of ether and alcohol, or into celluloid by treatment with nitro-benzol, naphtha or camphor, or mixtures of these solvents. Both of these products—collodion and celluloid—are highly inflammable. To do away with this objectionable feature, he proceeds to convert the dissolved pyroxylene back again to its original condition of cellulose, by treatment with suitable reducing agents.

This treatment, according to the inventor's explanation, consists in immersing the sheets, or other forms of collodion or celluloid, in a bath of ammonium sulphide, ferrous chloride (protochloride of iron), ferrous sulphate, or other chemically equivalent agents that will effect the necessary reactions, allowing them to remain in the bath until the mass of celluloid or collodion has been entirely reconverted or deoxidized. The resulting product is then to be washed and dried, after which it is in condition for use. The product thus produced is described as being extremely dense, tenacious and flexible, and is said to be applicable to the manufacture of belting, and many other useful purposes. From its transparent qualities, it may be used as a substitute for glass or mica, in places where it will not be subjected to high temperatures. It is described as possessing qualities which adapt it admirably as a substance from which to prepare the carbons of electric lamps.

If this product possesses, even in a measurable degree, the merits claimed for it by the inventor, he has made a most valuable discovery. A non-inflammable celluloid has long been a desideratum.

The Future of the Balloon.—At the last meeting of the American Association, two authors contributed papers on the subject of aerial navigation, and it is significant that both of them presented the view that the direction of discovery in the perfection of machines for aerostation would be towards improving the balloon, and not in the direction of the flying machine. This conclusion is contrary to the popularly received notions on the subject; and yet, we think, is entirely justified. There is little doubt that if the same amount of inventive ingenuity had been directed to the perfection of the balloon that has been devoted with such admirable results in other directions, it would have been by this time a practically useful instrument for aerial navigation. As it is, the balloon to-day is but slightly improved over what it was one hundred years ago when the Montgolfiers made their first fire balloons.

In Mr. Lynch's paper on "The Future of the Balloon as a Practical Means of Aerial Travel," the author affirmed that the two systems of aerial navigation—the balloon and the flying machine—are quite opposed to each other. In the flying machine, the wings or propellers are required to act upon the air to at once lift the dead weight of the machine and to propel it, or direct its course. The balloon, on the contrary, is itself a lifting power, lifting itself and carrying foreign weight that may be a force to direct or propel it. To cause a machine to fly that is heavier than the air, there is needed to merely lift it, the greater part, if not the whole, of the force that can in the present state of our knowledge be applied to it.

On the other hand, a machine (the balloon) that is lighter than the air will at least rise of itself and carry more or less surplus weight of force that may be applied to make it do something more than merely rise. The disadvantage of the balloon resides in its bulkiness, by reason of which it offers great resistance to the air in attempting to direct its course. Nevertheless, in the author's opinion, this advantage of the flying machine over the balloon counts but little, so long as it cannot both lift itself and carry the little extra weight of the force required to propel it.

The author concludes that the peculiar disadvantage of the balloon—its bulkiness—may be diminished, and the flying principle itself may doubtless be utilized to its full value in its application to the direction or propulsion of the balloon.

How the Diamond is Formed.—Mr. A. B. Griffiths, in the *Chemical News*, advances the idea that the diamond is formed in nature by the solvent action of highly heated water, or water gas, aided by enormous pressure, on the carbonaceous matter of fossils contained in sedimentary rocks, followed by slow cooling. He notes that there are but three ways in which crystals may be formed—namely, by fusion, by solution and by sublimation; and as the diamond generally is found in nature in an alluvial matrix of sandstone and pebbles, produced by the action of water, and as these formations are often fossiliferous, he draws the inference that the carbonaceous matter of the fossils (plant or animal remains) has been dissolved by highly heated water, aided by great pressure existing in the crust of the earth, and that on cooling the carbon has been deposited in the crystalline form of the diamond.

This view, he thinks, is far more rational than to suppose the diamond to have been formed by sublimation or from fusion. For the former supposition there are no facts to warrant an inference, either from experiment or in nature, while the latter hypothesis is rendered inadmissable from the well-known fact that carbon crystalizes from fusion in the form of graphite. On the other hand, the great solvent power of water, when aided by a high temperature and great pressure, is well known. It is manifested in its power to dissolve silica, as in the geysers of Iceland and elsewhere; and in the experimental researches of Senarmont and others on the artificial production of crystalized minerals, such as quartz, mispickel, corundum, heavy spar, etc., by the prolonged action of water at high temperatures and pressures. From these considerations, the author can see no reason why highly heated water or water gas should not have the power of dissolving the carbonaceous matter of fossiliferous plants and animals, and these on cooling depositing the carbon in the crystalized condition, forming the gem known as the diamond.

The Liquefaction of Ozone.—Messrs. Hautefeuille and Chappuis have made further experiments on the liquefaction of ozone with the aid of Cailletet's apparatus for the liquefaction of ethylene, and have obtained a deep indigo-blue liquid which can be preserved more than 30 minutes under a pressure of 75 atmospheres, and which evaporates somewhat slowly at ordinary pressures.

In performing their experiments, they compressed a mixture of oxygen and ozone at 125 atmospheres in the pressure tube of Cailletet's apparatus, the capillary tube being curved and the lower end cooled by a jet of liquid ethylene. If the mixture used does not contain more than 10 per cent (by weight) of ozone, the gas under 125 atmospheres pressure is not sensibly colored in the main part of the tube, but the blue color is very distinct in the cooled part of the capillary tube. Whether this coloration is due to a liquid mixture of ozone and oxygen, or to a thin film of liquid ozone alone, could not be definitely decided.

Sudden release of pressure produces no cloudiness. The tube, however, instantly becomes colorless, while a drop of a deep indigo-blue liquid (ozone) remains in the end of the capillary tube and evaporates very slowly. That the ozone is almost entirely liquefied, is shown by the fact that on again compressing the gas to 150 atmospheres no further coloration is produced. Although the ozone evaporates slowly, it diffuses somewhat rapidly. The gas above the almost black liquid is quite colorless, and it is only just when the last traces of the liquid disappear that the gas is seen to have a blue color.

The Influence of Manganese on the Strength of Iron.—A prize of $500 having been offered by the Society for the encouragement of Industry, in Prussia, for the best series of alloys of iron and manganese, two manufacturers submitted samples. According to the conditions of the competition, twenty rods of iron were to be sent, ten of an alloy of iron and manganese with less than 0.6 per cent of carbon, and not more than 0.4 per cent of impurities; and ten of an alloy rich in carbon, and in which the impurities were not to exceed 0.6 per cent. The proportion of manganese in the first series of samples was to increase gradually from 0.5 to 5 per cent, while the amount of carbon in the second series was to vary by the increments of at least 0.15 per cent. The rods or bars were to be perfectly homogeneous, and 19.685 inches long by 1.575 inches thick.

The chemical examination, which included a careful analysis of each bar, was carried out by Prof. R. Finkener, while the mechanical tests were intrusted to Prof. Spangenberg. The analyses of the first ten bars showed that the proportion of manganese varied from 0.42 to 0.88 per cent, while that of the carbon was from 0.36 to 1.94 per cent. The second series of ten alloys by the same maker was found to contain carbon in proportions varying from 0.29 to 0.74 per cent, instead of the stipulated minimum of 0.6 per cent. The percentage of manganese rose from 0.24 to 4.37. The first series of samples submitted by another firm contained: Manganese, 0.32 to 11.4 per cent; carbon, 0.58 to 2.42 per cent; maximum impurities, 0.92. The second series showed a gradual increase of manganese from 0.35 to 2.21 per cent, the amount of carbon rising at the same time from 0.58 to 2.9 per cent. From these analyses, it appeared that none of the competing series completely fulfilled the prescribed conditions with regard to chemical composition. It was found, in carrying out the physical experiments with these alloys, that they were extremely hard, and so brittle that they frequently flew into numerous pieces when subjected to a transverse strain. The tensile strength did not appear to bear any fixed relation to the amount of carbon or manganese present, and in many cases the alloy was not homogeneous. The impurities, especially the phosphorous, contained in the samples tested, may have had more influence on the mechanical results than either carbon or manganese.

Electric Current Produced by the Action of Light.—The following account is given by Mr. P. Laur's experiments in relation to the above: A glass vessel is placed in a dark chamber and filled with a solution of 100 parts of water, 15 of common salt, and 7 of sulphate of copper. A porous vase filled with mercury is placed in this solution, and two electrodes, one of platinum and another of sulphuret of silver, are inserted, the first into the mercury and the second into a cupric solution. These two electrodes are connected with a galvanometer; the apparatus is placed in the sun and the dark chamber shut. As soon as the circuit is closed the galvanometer needle turns in a direction which shows that the silver sulphuret is positive; when the needle comes to rest the shutter is opened, and the needle is immediately repelled, soon coming to a new position of equilibrium; on closing the shutter again, the needle slowly retrogrades towards its first position. When the needle is placed in the open air, if a cloud passes before the sun the movements of the needle show the variations of luminous intensity. The movements are attributed to the reduction of the silver sulphuret by the cupric protochloride, a reduction which takes place only under the action of the sun's rays.

Poisonous Coloring Matters in Food.—In France, where more decisive and summary methods of dealing with the adulteration of articles of food and drink are the fashion than here, a very sensible order has lately been issued by the Prefect of Police in Paris, forbidding the use of any of the following substances for coloring sweetmeats, liquors and foods: *Mineral Colors.*—The compounds of copper—blue verdigris, mountain blue; compounds of lead—oxides of lead, massicot and minium, oxychloride of lead, Cassel yellow, Turkish yellow, Paris yellow, carbonate of lead, lead white, antimoniate of lead, Naples yellow, sulphate of lead, chromates of lead, chrome yellow, Cologne yellow, chromate of baryta, yellow ultramarine; compounds of arsenic—arsenite of copper, Scheele's green, Schweinfurth green, sulphide of mercury, vermilion. *Organic Colors.*—Gamboge and Naples aconite; fuchsine and its sub-products, such as Lyons blue, eosine; nitro-derivatives, such as naphthaline yellow and Victoria yellow.

The restriction against the use of these substances in food products extends likewise to the coloring of wrapping papers for containing any kind of food; and manufacturers and dealers will be held responsible for any accidents that may occur through neglect or disobedience of the prohibition.

Ether Vapor as a Substitute for Hydrogen with the Oxyhydrogen Light.—Mr. Ives, of Philadelphia, has devised an ingenious arrangement, at once simple, compact and effective, for dispensing with the use of hydrogen or illuminating gas in using the oxyhydrogen jet for lantern demonstrations. His apparatus consists of a cylinder of brass about 10 or 12 inches in length, and capable of holding about a pint of ether. The cylinder is supported horizontally on a base, so that it may be placed conveniently near to the operator. It is filled with some porous substance capable of absorbing the ether, and then charged with the liquid. The cylinder is provided with suitable inlet and outlet tubes, controlled by stop-cocks. The oxygen is admitted to the cylinder, and, passing through the saturated porous mass contained therein, loads itself with ether vapor, and in issuing from the jet burns with a small but intensely hot flame, which, directed upon a block of lime in the usual way, gives a brilliant light which compares favorably with that obtained in the usual manner with hydrogen or burning gas. The portability and convenience of the apparatus will commend it to the favor of exhibitors and lecturers.

Transplanting Living Tissue.—An interesting surgical operation is reported to have been made recently by Dr. H. L. Little at the Hospital of Jefferson College, Philadelphia. It consisted in the removal of a portion of the conjunctive of the eye of a live rabbit to that of a young man whose eye had been badly injured with sulphuric acid. The surgeon removed the eye-lid from its firm adhesion to the eye-ball, and made it ready for receiving the new piece of membrane, which his assistants had meantime carefully dissected from the eye of the unconscious rabbit. The part was rapidly transferred to the under surface of the patient's eye-lid and neatly stitched in place. The operation is reported to have proved entirely successful. Here is a chance for the anti-vivisectionists to express their horror of the barbarities of modern science. The young man's eye may be restored to sight, but think of poor "bunny!"

The Dissociation of Chlorine at high temperatures, which was lately claimed to be a fact by the brothers Mayer as the result of experiments upon the vapor density of this element after subjecting it to very high temperatures, has been substantiated by Messrs. A. P. Smith and W. B. Lowe. These investigators found that chlorine, after being subjected to very high temperatures, will not decompose iodide of potassium in the same proportion as that of normal chlorine. For the purpose of their experiment, they passed a known volume of chlorine through a glazed porcelain tube heated to 1,030° C. (=1,886° F.) into potassium iodide, when less iodine was liberated than when the same volume of chlorine was passed through the same tube cold. The experiments of the brothers Mayer, and their confirmation by the investigators above named, have an important bearing on the question of the elementary character of chlorine.

Dark Bodies in the Solar System.—Sir John Lubbock's opinion endorses the conclusion long since put forth by some of the most eminent astronomers—namely, that there are now in the solar system, or firmament, many dark bodies—that is, bodies which now emit no light, or comparatively little. He points out, for example, that in the case of Procyon the existence of an invisible body is demonstrated by the movement of the visible star. Another illustration which he cites relates to the notable phenomena presented by Algow, the bright star in the Head of Medusa. This star shines without change for two days and thirteen hours; then, in three hours and a half, dwindles from a star of the second to one of the fourth magnitude; and then, in another three and a half hours, reassumes its original brilliancy. According to the view entertained by Prof. Lubbock, these changes must be regarded as indicating the presence of an opaque body, which intercepts at regular intervals a part of the light emitted by Algow.

Standard Sizes for Diaphragms.—From a reference in the *English Mechanic*, we learn that the Lens Committee of the (British) Photographic Society has reported a recommendation that the aperture of the standard unit diaphragm should have a diameter equal to one-fourth the equivalent focus of the lens, and that those with smaller openings should have apertures diminishing in area by one half, and should be marked 2, 4, 8, etc., thus indicating that if the unit stop needs an exposure of one second on any given paper, the use of a smaller stop would need a number of seconds corresponding to the number of the stop. Flanges and camera screws are recommended to be threaded with a standard series.

The report was adopted by the Council of the Society, and a series of standard flanges and camera was ordered to be constructed, to be kept in the custody of the society.

An Electric Arc Regulator, which the inventors, MM. Clerc and Bureau, of Brussels call, the "sun lamp" (*La Lampe Soleil*), and which was an acceptable illuminant of the picture gallery at the late Electrical Exhibition in Paris, is now employed in the foyer of the Grand Opera House of the same city, and has latterly been received with favor in the vaults of the Royal Exchange, London. It is as ugly as may be, whatever may be its other properties. Two holes are bored in a square block of marble or dry limestone, so that they slant toward each other and nearly meet at the base of the block. The carbons are inserted in these holes, and the current traversing them raises the partition of calcareous substance to incandescence. All accounts agree in stating that the light is soft, white and steady.

For Converting a Photographic Negative into a Positive, Capt. Bing coats the back of the negative with soluble bitumen or asphaltum, and exposes it to light through the negative. The parts through which the light penetrates become insoluble, and the remainder of the asphaltum is dissolved off with any of the usual solvents, leaving a positive. The silver negative is thereupon dissolved off with chloride of copper and a fixing agent, such as cyanide or hypo.

The Lumbering Industry.

Prof. Sargent's Forestry Bulletin No. 17, issued by the Census Office, is in the form of a table representing the volume, by states and territories, of the lumber industry of the United States for the census year, as derived from the returns of the enumerators on the schedules of manufactures, and from the reports of special agents for manufactures in cities having at the time of the ninth census 8,000 or more inhabitants. No distinction between the different kinds of wood sawed has been attempted in the enumeration. A comprehensive idea of the magnitude of the lumber industry is thus given.

It appears that in the United States the number of establishments for the manufacture of lumber is 25,708, employing a capital of $181,186,122. The statement of the number of hands employed in these establishments exhibits the following average: Males above 16 years, 141,564; females above 15 years, 425; children and youths, 5,967. The value of logs used amounted to $139,836,869; value of mill supplies, $6,318,516; wages paid during the year, $31,845,974. The following table exhibits the various products:

Feet of lumber (board measure)	18,091,356,000
Number of laths	1,761,788,000
Number of shingles	5,555,046,000
Number of staves	1,248,226,000
Number of sets of headings	146,523,000
Feet of spool and bobbin stock (board measure)	34,076,000
Value of all other products	$2,682,668
Total value of all products	$233,367,729

Of the 47 states and territories, Pennsylvania ranks first in the number of establishments with 2,827, followed closely by New York with 2,822; then comes Ohio with 2,352, Indiana with 2,022, and Michigan with 1,649. Of the Southern states, Virginia stands at the head with 907. The six New England states stand as follows: Maine with 848; Vermont, 688; New Hampshire, 680; Massachusetts, 606; Connecticut, 300; and Rhode Island, 49.

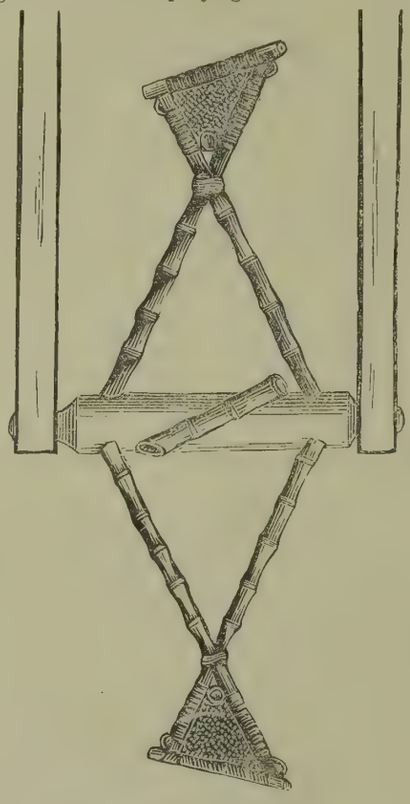
The number of establishments, however, give no idea of the magnitude of the industry in the several states, as, according to the amount of capital employed, Michigan stands far ahead, with $39,260,428, Pennsylvania coming next with $21,418,588, followed by Wisconsin with $19,824,059, and New York with $13,230,934. Ohio, which stands third in the number of establishments, employs a capital of $7,944,412. California, with its large way of doing things, employs a capital of $6,454,718 for 251 establishments, the cutting up of its monster trees being a work of considerable magnitude. The industry has not taken a deep root in Oregon as yet, considering that it has the most magnificent forests in America, for it has 228 establishments, with a capital of $1,577,875. Of the New England states, Maine employs a capital of $6,339,396; New Hampshire, $3,745,790; Vermont, $3,274,250; Massachusetts, $2,480,340; Connecticut, $657,300; Rhode Island, $144,250. The first four, it is thus shown, rank high, considering their size.

In the matter of the total value of all products, Michigan again stands way ahead with the figure of $52,449,928, followed by Pennsylvania with $22,457,359; Wisconsin, $17,952,347; New York, $14,365,910; Indiana, $14,260,830; Ohio, $13,864,460. Of the New England states, Maine makes the fine showing of $7,933,868, ranking next to Ohio. The total value of New Hampshire's products is $3,844,012; Vermont's, $3,258,816; Massachusetts', $3,120,184; Connecticut's, $1,076,455; Rhode Island's, $240,579.

In the number of feet of lumber produced, Michigan stands first with 4,172,572,000, followed by Pennsylvania with 1,733,844,000; Wisconsin, 1,542,021,000; New York, 1,184,220,000. Maine produced 566,656,000; Vermont, 322,942,000; New Hampshire, 292,267,000; Massachusetts, 205,244,000. The products of Massachusetts included 26,000,000 feet of lumber, 11,982,000 laths, and 127,591,000 shingles, manufactured from logs cut in New Hampshire and Vermont.

A Chinese Water-Wheel.

The ingenuity of the Chinese has passed into a proverb. They are credited, and justly, with having invented and applied many devices which have been re-invented by Western nations. Of the numerous discoveries and inventions that serve to distinguish this remarkable people, we need only name the mariner's compass, gunpowder, suspension bridges, and the art of silk culture—four subjects of preëminent importance, to which we might add others were the enumeration necessary to prove our statement. We content ourselves, however, with the description of one other invention—the vertical water-wheel, or current wheel, which appears to have been in use in China for ages for irrigating purposes. The wheel is extremely simple in construction, but none the less effective for that. It is made as follows, reference being had to the accompanying cut:



Chinese Water-Wheel.

Two upright posts are set firmly in the bed of the river, in a line at right angles with the banks, of a sufficient hight to raise the periphery of the wheel above the banks; in these the axle of the wheel is located. The balance of the wheel is formed entirely of bamboo. The rims, the spokes, the floats, the buckets, are made of entire lengths, or large pieces, or thin slices, or single joints of bamboo; neither nails, pins, screws, nor any other kind of metal are used; the parts are firmly bound together by cordage of light bamboo.

The wheel is thus framed: Sixteen or eighteen spokes are framed into the axis obliquely near the extremity, and cross each other at about two-thirds of their lengths. The wheel is strengthened where the arms cross, by a concentric circle, and the ends of the arms or spokes are secured to the two rims, the arm next the bank being fifteen inches shorter than the outer arm. Between the rim and the crossings of the spokes are triangular spaces, which are woven with close basket-work, and form the ladle-boards or floats. These successively entering the stream, are impelled by the current, and thus give motion to the wheel. The buckets are tubes of bamboo, closed at one end, and attached to the two arms of the wheel, and so fixed that when they are on a level with the axle they have an inclination of 25° to the wheel's axis. The closed end of the tube is, of course, the lowest, and it is fastened to the outer or largest rim. The open end is attached to the smaller rim nearest the bank. By this position the buckets, which dip into the stream as the wheel revolves, rise with their mouths uppermost; their inclination gradually changes as they rise, but not so much as to discharge their contents until they reach the top, when they pour their contents into a wide trough, from which it is distributed to the plantations.

These wheels are from twenty to forty feet in diameter, according to the hight of the land on the river bank, and the consequent elevation to which the water must be raised. A wheel of thirty feet carries twenty tubes or buckets 4 feet long and 2 inches diameter; each of them contains six-10ths of a gallon, or 12 gallons in the whole. With a stream of moderate velocity the wheel will make 4 revolutions per minute, and raise 48 gallons of water per minute, or 2,880 gallons in an hour, or 69,000 gallons per day. Thus, at a very trifling cost, a machine may be constructed which, without labor or attendance, will furnish a large and constant supply of water for agricultural purposes, at a considerable elevation.

Fire-Proof Cement.

A fire-proof cement is made from a material found in the Elfel Mountains. It is alleged by eminent professional men to be the only material of the kind which possesses, besides its plastic qualities, the virtue of being fire-proof. Moistened with water, this cement forms an elastic mass, which can be exposed, when dry, to great heat without shrinking or showing any cracks. The mode of its preparation is as follows: The cement is to be well mixed in a dry state, a small quantity of water is added and mixed well together. As a mortar, it can be used in the ordinary way. In lining furnaces, however, care must be taken to press the cement well into the walls, so as to leave a smooth, even surface, as when dried by the air the cement easily crumbles, and will not harden till ignited. Moreover, it must not be treated roughly until it has been well burnt. Cracks in furnaces, retorts, etc., should be well cleansed and scraped, and if possible roughed, before applying the cement. The parts to be mended should be damped beforehand. An analysis by Dr. Bischof, of Wiesbaden, gives the following results: The cement is a pale gray, gritty substance, consisting of a good deal of fine dust, with angular and round particles of quartz. When mixed with water it is very sticky, compact and easily molded. In 100 parts of the material, dried at 120° C., there were:

Clay earth	10.18
Silica, chemically combined	11.03
Silica, mechanically mixed (sand)	73.58
Iron oxide	0.41
Lime	0.23
Magnesia	0.17
Potassa	0.99
Loss by heat	3.46
	100.05

As will be seen, the quantity of fusible matter, such as iron, etc., is very small indeed, if any. Under the fire treatment the cement showed the following results: After being heated to silver-smelting heat, or about 1,000° C., the cement turned to a gray color, speckled with a few black spots, the fracture being earthy and porous.

The Amsterdam International Exhibition.—An international exhibition will be opened in Amsterdam, Holland, extending from May 1st to October 31st, 1883. The merchants and manufacturers of the United States are invited by Mr. S. A. Wheelwright, general agent, to open correspondence with him in regard to the matter, at the United Bank Building, No. 2 Wall street, this city.

The Boston Fair.

The Manufacturers and Mechanics' Institute Fair, an extended review of which we gave in our last issue, still remains open, and has proved the most successful fair ever held in New-England. It is not, like the exhibitions given by its older rival, a bazaar, but is in the truest sense an exhibit of the natural and mechanical resources of the country. It more nearly approaches a National exposition than anything ever before given in the metropolis of New-England.

The Institute has taken a position in regard to the non-distribution of awards to exhibitors which required considerable courage to introduce. The executive managers assume that the true province of an exposition is to bring buyers and sellers together, leaving to the former an unbiased exercise of judgment and to the latter the full power of presenting the merits of the articles they exhibit. The Institute assumes that the latter are competent to present their exhibits in the best possible light, and that the intending purchaser knows what he wants, and why an article which would suit another man would not fit his case. The exhibits are, in short, submitted with no extraneous aids to the tribunal of public opinion.

In practical value to New England, it must be conceded that the exhibits from the South eclipse all others. The Richmond and Danville Railroad Company has established a Bureau of Mines and Manufactures, its aim being to furnish a responsible official fountain of information from which all who may desire to settle in that country may draw freely. Its exhibit comprises, besides a large collection of hard and soft woods, a fine display of precious stones and valuable minerals. A case containing a lot of gems and gold and silver bullion, has attracted a great deal of attention. Here is displayed, among other gems, the "Hiddenite," (a species of emerald), sapphires, rubies, onyx, agates, garnets, emeralds, topazes and many other precious stones, and they give one an exalted idea of the natural wealth of the South.

There are large exhibits of asbestos, which has of late years become familiar by its frequent use as a non-conductor of heat. The varieties here are amithus, common asbestos, mountain cork, ligniform asbestos, mountain leather and mountain paper. There is also an exhibit of corundum, a rare and very valuable mineral, used for polishing steel and hard iron and other purposes. There are also fine specimens of materials used in the manufacture of porcelains, including porcelain clay, barytes, manganese, kaolin and feldspar; chrome ores (used for the manufacture of bi-chromate of potash), nickel ores, soapstones of several varieties, pure talc, plumbago, hones, whetstones, marbles, mica, etc.

The display of bright clean tobacco from North Carolina and Virginia is remarkably fine, and is valued at from twenty to one hundred dollars per hundred pounds. Several varieties of corn, oats, wheat and other cereals, of very fine grades are displayed.

The Chesapeake and Ohio and the Virginia, Tennessee and Georgia Air Line Railways are also represented by magnificent exhibits of coal, iron and wood. The coal, coke and iron are particularly noticable. The display of coal and the geological maps exhibited gives one a very good idea of the immense deposits of those invaluable commodities underlying Northern Georgia, Northern and Central Alabama, Virginia and West Virginia. There is also a good showing of copper ore and ingots, brown hematites and manganese, iron and zinc ores.

We have not space to give even an outline of the remarkable display of the natural products of the fields and forests and mines of the South. They offer to the thoughtful man suggestions of the most valuable character; they suggest the possibilities of a section of the country which to the average mind has been only known as a place adapted to the growth of cotton, tobacco, corn and bacon, and to the oppression of the black man. This exhibit will tend to elevate the South in the estimation of New Englanders, and may also tend to establish more familiar and friendly relations between the Yankee and the Southerner.

The building is illuminated by different systems of electric lighting, arranged so as to give each an equitable opportunity of showing the merits claimed for each light. The exhibitors are the Weston Electric Light Co. of New England; the American Electric Light Co., of New Britain, Conn., who show the Thomson & Houston system; and the Edison company. The Edison dynamos are driven by two Lawrence engines in the exhibit of A. F. Upton.

In the machinery section there is a waterfall about 30 feet in hight, which is supplied by a Follansbee wrecking pump. Near the base of this cataract the Deane Steam Pump Company, of Holyoke, Mass., have an extensive exhibit of their pumps, including mining, fire and boiler pumps, and a duplex pump which supplies a fountain in the center of the hall.

Hill, Clarke & Co., of Boston, have a very extensive exhibit of iron-working machinery, comprising the latest designs of the leading builders.

The Swampscot Machine Co., of South New Market, N. H., exhibit a 50 horse-power engine with their automatic cut-off, and several plain slide valve engines; also boilers, radiators and connections for steam heating.

Gardiner C. Hawkins, of Boston, shows two of his high-speed engines. They are vertical engines with slide valves, with the Mayer variable cut-off on the back.

A. F. Upton, of Boston, exhibits the Jarvis attachment to the Corliss boiler, and two Lawrence engines, the larger of which measures 12½ by 20 inches cylinder, and runs at 185 revolutions.

The Brayton petroleum engine attracts much attention. It is operated by the combustion of a mixture of petroleum and air. The base of the engine serves as a reservoir for the condensed air, and the oil is in a tank near by. This engine is said to give 5 horse-power net, and to consume one-sixth of a gallon of oil per hourly horse-power. The floor space, including fly-wheel, is 8 feet long by 2½ feet wide. It is virtually a gas engine, except that the combustion is not rapid enough to be termed an explosion. As in the case of gas engines, it is started by a match, no previous fire or preparation of any kind being necessary. This engine is exhibited by the Brayton Petroleum Engine Co., of 50 Federal street, Boston.

The Franklin Foundry and Machine Co. exhibit an improved spinning frame. It it one of their new pattern frames and the style which they are now building to great satisfaction. It comes fully up to its warrant of doing successfully any work required of a first-class frame. All the gearing is driven from one end, which effects a saving in power; and the head end is so built that the gears may be easily reached. The frame is running 144 Sawyer spindles, but is built in sizes from 128 to 256 spindles of the Sawyer, Rabbeth or Hopkins patent, and any gauge or space.

The Narragansett Machine Co., of Providence, R. I., manufacturers of bench, foot, power and amateurs' lathes, display their machines.

R. T. White, of Boston, exhibits his universal wood-worker. It seems to be a good machine, and does many kinds of work.

Wood-workers and the general visitor alike watch with pleased interest the operations of the Anderson spiral molder, on exhibition by its inventor, James Anderson. This machine is simple in construction, rapid, expeditious and efficient in action, and time and labor saving in principle. It is quickly adjustable to any required angle for turning any kind of spiral or twisted work, from the finest small designs up to the heaviest patterns, including stair banisters and other similar ornamental work.

Tennant & Hattersley, of Brooklyn, N. Y., display their Common-Sense patent metallic steam packing for piston rods, valve stems, cut-offs, etc.; also metallic joint gaskets for steam and water.

Bowers' patent flexible metallic packing is shown by Wood & Shattuck, of Boston.

Thomas Wise, of South Framingham, Mass., displays his steam fan blower for hot or cold blast.

The Gallagher Manufacturing Co., of Lynn, Mass., display their Champion and Universal ratchet drills, emery grinders, speed indicator, and cornice and pattern shears.

S. D. Hicks & Son display Austin, Obdyke & Co.'s celebrated expanding water conductor or rain-water spout.

The Eureka Wrench Co., of Great Falls, N. H., display the Eureka combination wrench

The Union Stone Co., of Boston, exhibit a full line of their emery wheels and emery wheel machinery for grinding and polishing. Mr. John F. Wood, the treasurer of this company, is the able treasurer of the fair, to whom so much credit for its success belongs.

A prominent exhibit of oak-tanned belting is made by Edward Page & Co., of Lawrence, Mass.

Among the interesting miscellaneous exhibits is that by the American Soapstone Finish Co., of Providence, R. I. They offer a patent soapstone finish for plastering as a substitute for hard finish now so generally used. It makes a smooth, durable finish of pearl-gray color, which can be easily washed when soiled, and is claimed to be superior to all others for painting or papering. An important fact in its favor is that it is non-absorbent—is not affected by heat or moisture.

The Curtis Regulator Co., of Boston, Mass., display the Curtis steam trap. The claim is made for this trap that it is the best in the market, in substantiation of which the company state that after its exhibition in the recent fair of the Massachusetts Charitable Mechanics' Association, in competition with other traps, it was purchased for permanent use in the exhibition building.

A. D. Waymoth & Co., of Fitchburg, Mass., exhibit Waymoth's new patent lathe, which is self-centering and self-adjusting. It is adapted for small wood-turning.

James Anderson, of Boston, exhibits a twisting machine for all kinds of spiral work.

H. B. Beach & Son exhibit their water-front tubular boiler, which seems to us to be an admirable generator in many respects. The makers claim that it is easier to fire than other boilers, is self-cleaning, that it saves fuel and repairs. This boiler occupies a prominent place in the center of the building.

A Pocket Photometer.

Mr. Robert Sabine, the well-known electrician, has devised a handy little pocket photcmeter which will be useful for estimating approximately the intensities of different electric lights. It is based on Ritchie's method, and consists of a telescopic tube having at one end a square box, two opposite sides of which are glazed with squares of opal glass cut from the same sheet. Within this box is a prism, or angle of a prism, made up of two plane mirrors meeting each other at a right angle, the apex of which points up the telescopic draw-tube. This tube is fitted with an eye-piece at the other end, and a small lens, so as to get a good focus in order to see the mirrors plainly. The principle of Ritchie's photometer consists in comparing the intensities of the two lights as reflected on the mirrors (or white card surfaces); and the observer moves until the relative distances between himself and the lights give a sensibly equal illumination of the mirrors. These distances then give the relative intensities of the lights by the law of inverse squares. In Mr. Sabine's photometer the lens and draw-tube take the place of the small hole employed by Ritchie; and this requires the tube to be drawn out about four inches. Were it not for the lens the tube would require to be much longer in order to get a good view of the mirrors. The instrument is made by Messrs. Elliott Brothers, the well-known opticians.

Market Report of Building Materials.

NEW YORK PRICES.

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LUMBER.

Pine, very choice and extra dry, ₱ M	$65 00 @ 75 00
Pine, good	55 00 @ 60 00
Pine, shipping box	21 00 @ 22 50
Pine, common box	18 00 @ 20 00
Pine, common box ⅝	16 00 @ 18 00
Pine, tally plank, 1¼, 10 inch, dressed each	— 44 @ — 50
Pine, tally plank, 1¼, 2d quality	— 35 @ — 38
Pine, tally plank, 1¼, culls	— 28 @ — 30
Pine, tally boards, dressed, good	— 30 @ — 32
Pine, tally boards, dressed, common	— 25 @ — 28
Pine, tally boards, culls, dressed	— 24 @ — 25
Pine, strip boards, merchantable	— 18 @ — 20
Pine, strip boards, clear	— 24 @ — 26
Pine, strip plank, dressed, clear	— 33 @ — 35
Spruce boards, dressed	— 25 @ — 26
Spruce plank, 1¼ inch, dressed	— 28 @ — 30
Spruce plank, 2 inch	— 43 @ — 45
Spruce wall strips	— 15 @ — 16
Spruce timber, ₱ M	19 00 @ 21 00
Hemlock boards, ₱ M	17 00 @ 18 00
Hemlock joist, 2½x4, each	— 16 @ — 17
Hemlock joist, 3x4	— 18 @ — 20
Hemlock joist, 4x6	— 40 @ — 44
Ash, good, ₱ M	55 00 @ — —
Oak	60 00 @ 65 00
Maple culls	25 00 @ 30 00
Maple good	45 00 @ 50 00
Chestnut	48 00 @ 52 00
Cypress, 1, 1½, 2, and 2½-inch	35 00 @ 40 00
Black Walnut, good to choice	120 00 @140 00
Black walnut, ¾-inch	85 00 @100 00
Black walnut, selected, and seasoned	150 00 @175 00
Black walnut, counters, ₱ ft	— 22 @ — 28
Black walnut, 5x5	150 00 @160 08
Black walnut, 6x6	160 00 @170 00
Black walnut, 7x7	175 00 @180 00
Black walnut, 8x8	175 00 @180 00
Cherry, wide, ₱ M	100 00 @120 00
Cherry, ordinary	60 00 @ 80 00
White wood, inch	45 00 @ 50 00
White wood, ¾-inch	35 00 @ 40 00
White wood, ⅝ panels	42 00 @ 45 00
Shingles, extra sawed pine, 18-inch	4 50 @ 5 50
Shingles, clear sawed pine, 16-inch	4 00 @ 4 50
Shingles, cypress, 24x6	18 00 @ 20 00
Shingles, cypress, 20x6	11 00 @ 12 00
Lath, Cargo rate	2 30 @ 2 40
Yellow dressed pine flooring	30 00 @ 40 00
Yellow pine girders	32 50 @ 40 00
Locust posts, 8 feet, ₱ inch	— 18 @ — 20
Locust posts, 10 feet	— 24 @ — 25
Locust posts, 12 feet	— 29 @ — 34
Chestnut posts, ₱ ft	— 3 @ —3½
Basswood ₱ M	25 00 @ 30 00

Cargo rates 10 ₱ cent off.

CEMENT—PER BARREL.

Portland (imported)	2 75 @ 2 85
Portland (American)	2 30 @ 2 75
Portland (Lafarge)	3 60 @ 3 75
Lime of Teil	2 30 @ 2 50
Lime of Teil, ₱ ton	15 00 @ 18 00
Roman	3 00 @ 3 25
Keene's & Martin's, coarse	9 50 @ 10 00
" fine	12 00 @ 13 00
Rosendale	1 20 @ 1 25

SOLDERS.

Half and half	16½ @ — 16¾
Extra	15½ @ — 15¾
No. 1	14 @ — 14¼

ZINC.—Duty, sheet, ₱ lb, 2½ cents.

Sheet (cask) ₱ lb	6⅞ @ — 7½
Sheet (open)	7½ @ — 8

BRICKS.

	Cargo.		Afloat.
Pale, ₱ M	4 25	@	5 00
Up Rivers	7 50	@	8 00
Jersey	7 25	@	8 00
Haverstraw Bay	7 75	@	8 00
" " choice	8 25	@	8 50
Favorite Brands	8 75	@	— —
Hollow Fire-Clay Brick	9 00	@	9 25

FRONTS.

Croton—Brown, ₱ M	11 00 @ 13 00
" Dark	13 00 @ 15 00
" Red	13 00 @ 15 00
Philadelphia, on pier	30 00 @ — —
Trenton "	30 00 @ — —
Baltimore "	38 00 @ 40 00
Clark's Glens Falls, White	30 00 @ — —
" " Red Fronts	27 50 @ — —
" " Molded Red and White	45 00 @ 80 00

Yard prices 50 cents ₱ M higher, or with delivery added $2 ₱ M for hard and $3 ₱ M for front brick. For delivery add $5 on Philadelphia, Trenton and Glens Falls and $6 on Baltimore brick.

STONE.—Cargo Rates Delivered in New York.

Amherst Freestone, No. 1, in rough, ₱ c. f	1 00 @ — —
do do No. 2	— 85 @ — 95
Bedford Stone	1 25 @ — —
Berlin Freestone, in rough	— 75 @ 1 00
Berea Freestone, in rough	— 75 @ 1 00
Brown Stone, Portland, Conn	1 00 @ 1 35
Bay of Fundy Wood Point Brown Stone	1 00 @ — —
do Mary Point Brown Stone	1 00 @ — —
do do Olive Stone	1 00 @ — —
Brown Stone, Belleville, N. J	1 00 @ 1 35
Granite, rough	— 60 @ 1 25
Canaan Marble	1 25 @ 1 50
Sutherland Falls Marble	1 25 @ 1 75
Dorchester, N. B., Stone, rough, ₱ foot	1 00 @ — —

LEAD—PER 100 POUNDS.

German	— — @ — —
English, common	— — @ — —
Spanish	5 75 @ — —
Foreign, refined	— — @ — —
Bar	6 50 @ — —
Sheet	7 50 @ — —
Pipe	— — @ — —
Domestic	4 63 @ — —

SLATE.

Purple, roofing slate, ₱ square	$7 00 @ 8 00
Green Slate	7 00 @ 8 00
Red Slate	15 00 @ — —
Black Slate, Pennsylvania, (at Jersey City)	4 75 @ 5 25
Slate tiles, 1¼-inch, rubbed, ₱ square foot	— 20 @ — 25

TIN PLATES.—Duty, 1⁷⁄₁₀ cents ₱ lb.

I. C. charcoal, 10x14, ₱ box	6 25 @ 6 75
I. C. coke, 10x14	5 25 @ 5 75
I. X. charcoal, 10x14	8 25 @ 8 37½
I. C. charcoal, 14x20	6 25 @ 6 75
I. X. charcoal, 14x20	8 25 @ 8 37½
I. C. coke, 14x20	5 25 @ 5 75
I. C. coke, terne, 14x20	5 25 @ 5 37½
I. C. charcoal, terne, 14x20	5 37½@ 5 75

NAILS—PER KEG.

10d to 60d, common, fence and sheathing	3 30 @ 3 40
8d and 9d, common	3 65 @ — —
6d and 7d, common	3 90 @ — —
4d and 5d, common	4 15 @ — —
3d and 4d, light	4 95 @ — —
3d, fine	5 65 @ — —
2d, fine	5 65 @ — —
Cut spikes, all sizes	3 65 @ — —
Clinch nails, 1½ to 1¾ inch	5 65 @ — —
do. 2 to 2½ inch	5 40 @ — —
do. 2½ to 2¾ inch	5 15 @ — —
do. 3 inch and longer	4 90 @ — —

IRON—PER TON.

Duty.—Bar, 1 to 1½c. ₱ lb. ; Railroad, 70c. ₱ 100 lb. ; Boiler and Plate, 1½c. ₱ lb. ; Sheet, Band, Hoop, and Scroll, 1¼ to 1¾c. ₱ lb. ; Pig, $7 ₱ ton ; Polished Sheet, 3c. ₱ lb. Galvanized, 2½c. ₱ lb. ; Scrap cast, $6 ₱ ton ; Scrap Wrought, $6 ₱ ton—all less 10 ₱ cent. No Bar Iron to pay a less duty than 35 ₱ cent ad val.

Pig, Scotch—Coltness	27 50 @ 27 75
" Glengarnock	25 00 @ 25 25
" Eglinton	23 50 @ 24 00
" American, No. 1	26 00 @ 27 50
" American, No. 2	24 00 @ 25 00
" American forge	22 50 @ 23 50

PAINTS.

Carmine, American, ₱ lb	5 00 @ 5 25
Chalk, ₱ 100 lbs	— 35 @ — —
China Clay, ₱ ton	18 00 @ 20 00
Chrome yellow, dry, ₱ lb	— 12½ @ — 28
Lead, red American, ₱ lb	— 6¾ @ — 7
Lead, white American, pure, in oil	— 7½ @ — 8
Lead, white American, pure, dry	— 6¾ @ — 7
Lead, white English, pure, in oil	— 9 @ — 10
Litharge	— 6¾ @ — 7
Ocher, Fr., dry, ₱ 100 lbs	1 50 @ — —
Ocher, ground, in oil, ₱ lb	— 6 @ — 15
Ocher, Vermont, ₱ 100 lbs	— 75 @ 1 00
Orange Mineral, English	— 9 @ — 10
Paris White, American	— 1½ @ — 1¾
Paris White, English, prime	— 2 @ — 2¼
Paris Green	— 15 @ — 28
Plumbago paint, patent, ₱ lb	— — @ — 25
Putty, ₱ lb	— 2 @ — 2½
Spanish Brown, dry, ₱ lb	— 1¼ @ — 1¼
Spanish Brown, ground in oil, ₱ lb	— 8 @ — 9
Venetian red, ₱ cwt	1 75 @ 2 00
Vermilion, Chinese, ₱ lb	— 85 @ — 90
Vermilion, Trieste	— 70 @ — 75
Vermilion, quicksilver, bags	— 50 @ — 52½
Vermilion, American, common	— 15 @ — 18
Whiting, ₱ 100 lbs	— 60 @ — 80
Zinc, white American, dry, No. 1	— 5 @ — 7½
Zinc, white American, No. 1, in oil	— 8 @ — 10
Zinc, white French, dry, (Red Seal,)	— 7 @ — 8
Zinc, white French, in oil	— 10 @ — 10½

VARNISHES—PER GALLON.

American Wearing Body	3 50 @ 4 00
Coach Body	2 35 @ 3 50
" "	1 80 @ 2 00
Furniture	1 25 @ 2 50
Black Asphaltum	1 00 @ 1 50
Brown Japan	1 00 @ 1 20
Liquid Paint Dryer	1 35 @ 1 75
Harness, (black)	3 00 @ 4 50
Shellac, Spirits	3 00 @ 3 50

LIME—PER BARREL.

State, common	1 00 @ — —
" finishing	1 10 @ 1 15
Rockland, common cargo rate	1 10 @ — —
" finishing	1 20 @ — —
Ground	— 90 @ 1 00

Add 25 cents to above figures for yard rates.

HAIR.

Cattle, ₱ bushel of 7 lbs	— 18 @ — 21
Goat " "	— 32 @ — 35

PLASTER PARIS.

Duty.—20 ₱ cent ad. val. on calcined ; lump free.

Calcined, ordinary city, ₱ bbl	1 30 @ 1 35
Calcined, city casting	1 50 @ 1 65
Calcined, city superfine	1 70 @ 1 75

MAHOGANY.

St. Domingo, crotches, ordinary to good, ₱ ft	— 15 @ —20
St. Domingo, crotches, fine	— 20 @ —30
St. Domingo, logs, small	— 5 @ — 8
St. Domingo, logs, large	— 8½@ —14
Frontera, Mexican, large	— 12 @ —15
Frontera, Mexican, small	— 6 @ — 8
Other Mexican	— 9 @ —11
Honduras	— 6 @ —12½
Rosewood, ordinary to good, ₱ lb	— 2½ @ — 4½
" good to fine	— 5 @ — 8
Satin Wood, ₱ foot	— 15 @ — 75
Tulipwood, ₱ lb	— 6 @ — 7
Lignumvitæ, large, ₱ ton	30 00 @ 50 00
Lignumvitæ, other sizes	10 00 @ 25 00

CEDAR.

Cuba and Mexican, small, ₱ super. ft	6 @ — 7½
Cuba and Mexican, medium	8 @ — 9½
Cuba and Mexican, large	10 @ —11
Florida, ₱ cubic foot	40 @ —75

DEADENING AND ROOFING MATERIAL.

Mineral wood for Roofs and deadening, ₱ lb	— 1¼ @ —1½

LABOR.

Ordinary,	₱ day	2 00 @ 2 50
Masons,	do	3 50 @ 4 00
Plasterers,	do	4 00 @ — —
Carpenters,	do	4 00 @ — —
Plumbers,	do	4 00 @ 4 50
Painters,	do	3 00 @ 3 50
Stone-Cutters,	do	3 00 @ 3 50

REVIEW OF THE MARKETS.—In the lumber market during the past month the general tendency has been to take a favorable view of the situation, and most operators speak cheerfully of the present and hopefully of the future. The arrivals coastwise have thus far been absorbed without much difficulty, and for some goods especially good lengths of spruce, the demand is by no means satisfied, while the distribution has been fair of most staple descriptions. The foreign outlet, however, appears to have given the most positive and regular movement, and afforded the greatest advantage to sellers, the shipments already made having reduced and broken up assortments to to some extent.

In the brick market common hards have undergone no change so far as the general features of the market are concerned, sellers retaining about all the advantage and the line of valuation reaching a still higher level. Consumption has been unchecked, the condition of the weather permitting steady work, and if there was any stock in excess of the wants of contractors dealers could be found who were willing to handle it. Fancy front stock has been firmly held.

In the cement market for domestic brands there has been an active and hardening market. Large amounts have been taken for shipment to the interior and coastwise, and local buyers have found it a somewhat difficult matter to secure attention, especially when they desired the favorite brands. Foreign brands have been irregular, and the market not very well sustained.

In the lath market exact values seem to be somewhat uncertain, though $2.30 seems to be considered inside, and how much higher will depend upon the competition over the next offering.

In the lime market the position has been somewhat nominal. On both Eastern and State "former rates" have been quoted, but the position has scarcely undergone a good test of late, and it will require more general operations to fully determine matters.

In the hardware market business has continued slow on all outlets and we have heard less of the cheerful predictions about the good trade to come. We have heard rumors, however, of occasional quiet cutting and it is quite likely that desirable customers have by careful management, obtained some favors.

In the paint market a slow and at times somewhat uncertain movement of supplies has taken place with the market irregular. As a rule the buyer has had no positive advantage, but has picked up a comparatively cheap invoice now and then, and always found sellers willing to negotiate. The assortment available has admitted of any ordinary selection, either as to quantity or quality.

In the nail market sellers report a strong market at full rates and small broken assortments. Buyers, however, say they have experienced less difficulty in filling orders than a short time ago, and admit extreme rates only an small jobbing parcels.

In the metal markets Scotch pig has been fairly active and has been commanding about former rates. American pig has met with rather an uncertain demand, and there appears to have been an increased feeling of caution among buyers. The deliveries on contract, however have kept supplies quite closely sold up, and with no accumulation of stock to trouble them holders have been firm. Manufactured iron has not been very active on new orders, but fair deliveries have been making on contract, and the line of prices has kept quite steady. For domestic pig lead the demand of late has been principally of a jobbing character, while manufactures of lead have been steady. Tin in pig has met with a somewhat fluctuating demand, and the market has been correspondingly unsettled, but during the greater portion of the period since our last, the tendency has been in buyers' favor. Offerings have been fair, and some holders a little more anxious. Tin plates have been in most cases held with a display of some little firmness and owners have not appeared over anxious to realize. The demand, however, has not been altogether satisfactory and extreme rates have been made only on small lots. Sheet zinc has been selling moderately in small lots from store.

House Drainage.

From the able report of Mr. Wm. Paul Gerhart to the State Board of Health of Rhode Island, we are enabled to glean the following useful points upon house drainage and sanitary plumbing:

The matter of the present communication relates to traps in the main drain between the sewer, cesspool or flush-tank, and the fresh-air pipe. Such a trap may be considered as a necessity. It consists in its simplest form of a simple bend or dip in the drain, which retains a sufficient quantity of water to pre-

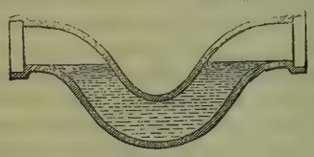


Fig. 1.

vent the passage of air or sewer gas from the sewer to the house drain. Fig. 1 shows the common running trap as manufactured in earthenware. Figs. 2 and 3 represent a form of cast iron trap manufactured by the J. L. Mott Iron Works, of this city, with a cleaning and inspection hole at the house side of the water-seal, which serves in some cases, when the trap is placed in a man-hole outside of the house, and covered by an open grating, as a fresh-air inlet. Fig. 4 shows a combination of trap and fresh-air inlet, located outside the house, a modification approved by the Massachusetts State Board of Health.

The objections that have been urged against traps in the main drain deserve consideration. They are: 1st that they impede the ventilation of the public sewers; 2d, that they form an obstruction to the flow of the sewage in the house drain, and are, therefore, the cause of accumulations of foul matter in the drains; and, 3d, that foul matter will lodge in the trap.

Respecting the first objection, the author is of opinion that proper ventilation of sewers can be effectu-

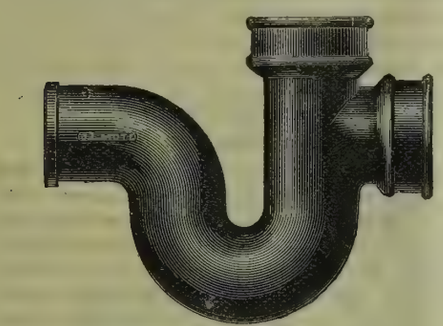


Fig. 2.

ally carried out without ventilating through the house; and this he proves by instancing the practice of house drainage in vogue in the cities of Memphis (Tenn.), Frankfort-on-the-Main, Hamburg, Danzic, Berlin, Breslau, etc. Respecting the other objections, he urges that no serious trouble from obstructions in the drain will be met with if it is carefully laid with sufficient and continuous fall to insure a cleansing velocity of the flow. Where this fall cannot be given, flushing appliances should be used. A grease trap of proper construction is also important.

Says the author: "If we could have *ideal* sewers, house drains and soil pipes, it might perhaps be possible to dispense with the trap in the main drain altogether. But since all sewers may have temporary stoppages from some cause, since house drains may settle or leak, and joints of soil pipes crack, thus allowing sewage matter to undergo putrefaction, and enter the interior of houses, I would in all cases advise the use of a safeguard, consisting of a disconnecting trap and a *well ventilated soil pipe*. This lat-

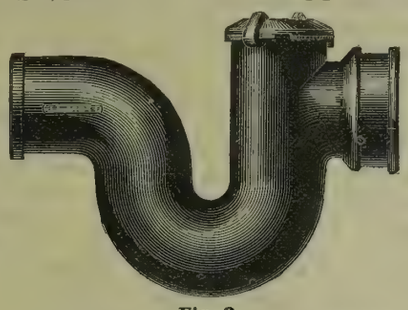


Fig. 3.

ter arrangement is a *conditio sine qua non;* and rather than have a trap *without* ventilation, I would advise to have none at all."

As another essential to sanitary house plumbing, the author names the trapping of fixtures—that is, a suitable trap placed as near as possible under each fixture. These traps become a necessity, from the fact that much of the so-called "sewer gas" is actually generated in the very drains and soil pipes of the house. The trapping of the main drain would prove ineffective, and would offer no protection whatever against the foul gases derived from organic matter decomposing within the pipes.

These traps should be placed as close as possible to

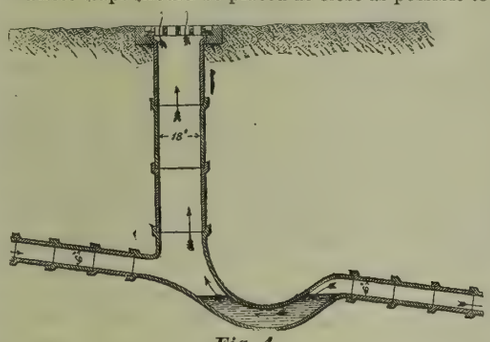


Fig. 4.

the fixture, to reduce the length of waste pipe on the house side of the trap; it should be made preferably of lead, as this permits of making a good joint with the lead waste pipes; it should be *self-cleansing*, and square corners and large spaces should be avoided; the dip, or "water seal," should not be too great, though great enough to prevent unsealing by siphonage, evaporation or back pressure.

He distinguishes "water seal" traps, and "mechanical" traps. The characteristics of all water seal traps is that they have in their lowest part a bulk of water divided by a dip in the pipe, so as to stand on the house side as well as on the sewer side, one or several inches higher than the lowest point of the dip, thus making a seal, which, under ordinary circumstances, prevents the passage of gases. The traps of the second class have, in addition to the water

Fig. 5.

seal, mechanical contrivances, such as floats, balls, valves, flaps, etc., to exclude sewer gas.

Fig. 5 represents one of the water seal traps, of the form manufactured by F. Adee & Co., of this city. The mechanical traps are legion, and many of them are very ingenious. Fig. 6 represents Waring's check valve, in which the valve forms a seal by its weight, and the seal is dependent upon the accuracy of the turned seat. Fig. 7 shows Cudell's trap, constructed on much the same principle as the former, but having a heavy metallic ball instead of a conical shaped valve. Nicholson's "mercury seal" trap, shown in Fig. 8, has an inverted porcelain cup inside of its cylinder, the edge of which rests on mercury, forming a tight seal. The cup is lifted at each discharge, by the force of the water entering at the bottom of the cylinder, and after the water has passed from the

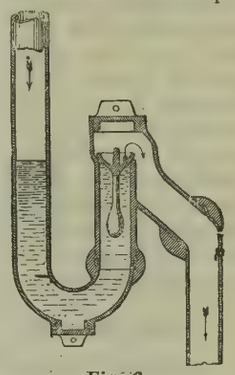


Fig. 6.

basin the cup falls back to its place. This form of seal is referred to as being very efficient.

Early Notions of Electricity.

Dr. Lieberkühn, of Berlin, describes the startling results which he obtained, or imagined, "when a nail or a piece of brass wire is put into a small apothecary's phial and electrified." He says that "if, while it is electrifying, I put my finger on a piece of gold which I hold in my hand to the nail, I receive a shock which stuns my arms and shoulders." At about the same date (the middle of the last century), Muschenbroek stated, in a letter to Réaumur, that, on taking a shock from a thin glass bowl, "he felt himself struck in his arms, shoulders and breast, so that he lost his breath, and it was two days before he recovered from the effects of the blow and the terror;" and that

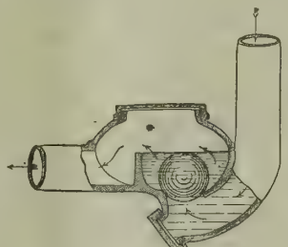


Fig. 7.

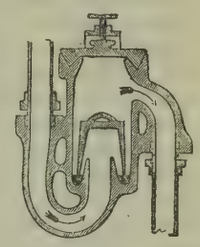


Fig. 8.

he "would not take a second shock for the kingdom of France." From the description of the apparatus, it is evident that this dreadful shock was no stronger than many of us have taken scores of times for fun.

Conjurers, mountebanks, itinerant quacks, and other adventurers operated throughout Europe, and were found at every country fair and *fête* displaying the wonders of the invisible agent by giving shocks and professing to cure all imaginable ailments. Then came the discoveries of Galvani and Volta, followed by the demonstrations of Galvani's nephew Aldini, whereby dead animals were made to display the movements of life, not only by the electricity of the voltaic pile, but, as Aldini especially showed, by a transfer of the mysterious agency from one animal to another. According to his experiments (that seem to be forgotten by modern electricians), the galvanometer of the period—a prepared frog—could be made to kick, by connecting its nerve and muscle with the nerve and muscle of a recently killed ox, with or without metallic intervention.

Thus arose the dogma which still survives in the advertisements of electrical quacks, that "electricity is life," and the possibility of reviving the dead was believed by many. Executed criminals were in active demand; their bodies were expeditiously transferred from the gallows or scaffold to the operating table, and their dead limbs were made to struggle and plunge, their eyeballs to roll, and their features to perpetrate the most horrible contortions by connecting the nerves with one pole and the muscles with the opposite pole of a battery.

The heart was made to beat, and many men of eminence supposed that if this could be combined with artificial respiration, and kept up for a while, the victim of the hangman might be restored, provided the neck was not broken. Curious tales were loudly whispered concerning gentle hangings and strange doings at Dr. Brookes', in Leicester Square, and at the Hunterian Museum, in Windmill street, London, now flourishing as the Café de l'Etoile. When Bishop and Williams were hanged for "burking," *i. e.*, murdering people in order to provide "subjects" for dissection, their bodies were sent to Windmill street, and the popular notion was, that, being old and faithful servants of the doctors, they were galvanized to life, and again set up in their old business.

The American Institute Fair.

The American Institute Fair has been more successful, from a financial standpoint, this season than usual, the attendance having been good since the opening day. Visitors find much to interest them, and while a goodly number of the exhibits have been seen at previous fairs, there are enough novelties displayed to make the exhibition interesting.

The Babcock & Wilcox boilers are doing splendid duty, as might be expected from the record of these excellent generators. E. F. Loiseau, of Philadelphia, has been employing his fuel, made from anthracite coal dust, under the boilers with the most satisfactory results. This fuel is made by the Loiseau Fuel Co., of Philadelphia, and, as employed under the Babcock boilers, is of egg-shaped form, each lump weighing two ounces. The manufacturers state that the lumps are made from this weight up to one pound. Mr. Loiseau's invention seems destined to become of great value, utilizing as it does a waste product into fuel for domestic and manufacturing purposes. Robert Whitehill, of Newburgh, N. Y., displays a Whitehill engine, which furnishes the motive power to the machinery in operation. The Westinghouse engine exhibit continues to excite admiration. It furnishes power to the electric generators. The United States Electric Lighting Co. makes a very fine exhibit of electric light generators and large lights for illuminating the hall. On the two side aisles their incandescent system is employed, and compares, in our judgment, favorably with the Edison system now being introduced in the lower part of our city.

We were especially interested in the exhibit of E. E. Garvin & Co., who show a number of their machinists' tools. They claim to make as good a milling machine as any in the market, at a considerably lower price, and we think their claim fully justified. All their machines are well constructed, being substantially built, without complication of parts or superfluity of material. The Blake crusher grinds out rock as in years past, and grates just as painfully on the ears. Several rock drills are shown; one of these, propelled by foot-power, is claimed by its inventor to drill one foot an hour. The inventor sits back in his chair with arms folded, propelling the treadle with his feet. Several hot-air engines are displayed; the most prominent of these is the Ericsson, made by the Delamater Steam Pump Co., of this city, who also exhibit the Delamater pump. The Pulsometer pump is largely displayed by the Pulsometer Steam Pump Co., of this city. The New York Safety Steam Power Co. display their vertical engines in a variety of sizes. The Niagara steam pump is running one of the cider mills at the fair. A beautiful Holtz electrical machine, made from plans of Mr. C. Van Brunt, of this city, is on exhibition. A pin machine is shown in operation, and is alone well worth a visit to the fair. The Terra-Cotta Lumber Co., of this city, have a fine display of their fire-proof material, or terra-cotta lumber, as they term it. This substance seems to us to possess all the qualifications of an absolutely fire-proof material, while its nature renders it practicable to drive nails through it so that it can be used as readily as ordinary lumber. The Flushing Lumber and Building Co. exhibit a two-story portable house, which attracts much attention. There are two rooms on the first floor—a living room and kitchen, and above two bedrooms of moderate dimensions. This form of constructing houses has of late been making rapid advances, owing to the great demand for such buildings from Central and South American countries and the West Indies.

Among the miscellaneous exhibits there is a fine display of gas stoves for heating and cooking purposes, and in this department the proud housekeeper will find many splendid devices. No field of invention of late years has been more fertile of results than this, the result of the introduction of the electric light and the efforts of the gas companies to find other uses for gas than illumination solely. Other domestic appliances are shown in great number. There are some excellent refrigerators displayed, and the exhibits of furniture are extensive and very elegant. Silk looms are shown in operation, making colored handkerchiefs of fancy patterns, and attract their crowds of inquiring visitors. A chicken incubator on improved principles of construction is shown.

An electrical appliance displayed near the entrance, not only lights the gas, but is shown arranged to a front door, so that by simply pulling the bell-knob the visitor lights the gas in the hall while ringing the bell. A Persian exhibit is one of the features of the fair, and next to it is a splendid display of ceramics. The Gold Heater Co. show the Gold sanitary heater. The lightning grease eradicator man is on hand, and fair maidens with atomizers perfume the passers-by. The Jerome Kidder Co. display a fine lot of electrical machines, while the exhibit of the S. S. White Dental Company is of surprising beauty, containing as it does all the tools and most approved appliances used by dentists, including the electric drill. The most recent advances in the manufacture of artificial teeth are also displayed. Numerous other exhibits are shown, and it would consume more space than our pages will allow to notice even briefly the many attractions that are contained in the Institute building.

Miscellaneous and Advertising.

Foot Power Machinery, for workshop use will be sent on trial if desired by W. F. & John Barnes of Rockford, Ill.

The George Place Machinery Company, of 121 Chambers street, this city, have always on hand a large line of new and second-hand machinery of every description.

"How to Keep Boilers Clean," and other valuable information for steam users and engineers. Book published by James F. Hotchkiss, 84 John street, New York. Mailed free to any address. (Mention this paper.)

The New York, Providence & Boston Railroad Company are putting in two Improved Bucket Plunger Steam Pumps, made by the Valley Machine Company, at Easthampton, Mass., to replace two of the old style pumps of same make which have been in use twelve years.

The Hartford Engineering Company of Hartford, Conn., have just received an order for 50 steam engines of from 20 to 30 horse-power, the engines being intended for export. And Beatty, the organ man, at Washington, N. J., has ordered a duplicate of his present engine, size 16 by 30 inches, that has developed 210 indicated horse-power.

The experiment of pumping boiling hot molasses with the New Pulsometer was tried successfully a short time ago by the Pulsometer Steam Pump Co. at the New England Manufacturers' and Mechanics' Institute Fair, Boston. This pump, being set up especially for that purpose, handled the liquid with as much ease, while at the temperature of 212° Fah., as it would at 50°. The manager of a large sugar estate in the island of Cuba, who was present at the test, was so pleased with the working that he has since ordered one of them for his estate, and says that in his opinion it is the coming pump for sugar-house use.

The past year has been a very busy one at the manufactory of the S. A. Woods Machine Co., South Boston, Mass. A large increase in production has been made this year, and an additional number of men have been employed, the total number being now 230. There are now many orders ahead, and in order to provide more working space and also more room for the patterns, the company have just erected a large brick building in which to store patterns, etc., and will utilize the former pattern rooms for workrooms. The orders for the machines come from all parts of the United States, and a large and increasing trade is done with South America, mainly Brazil, and some orders have also been received from Australia. The warerooms of the S. A. Woods Machine Co., in this city are at 91 Liberty street.

The model steel works of Carnegie Bros. & Co. (limited) of Pittsburgh, Pa., are located at Bessemer Station, on the main line of the Pennsylvania Railroad, eleven miles east of Pittsburgh. The area of the works cover 106 acres, and a river frontage on the Monongahela river of 3,300 feet, in addition to the railroad afforded by the Pennsylvania Railroad, which traverses the plant. Their C furnace, blown November 8th, 1881, turned out by September 1st, 1882, 45,028 tons of Bessemer pig iron, this production being an average of 1,070 tons per week, and has now reached a weekly product of 1,500 tons. The rail mills bloom large ingots and roll blooms into single and double length rails. The present production of the works per week is estimated at: Blast furnaces, 5,000 tons; converting department, 6,000 tons; rail and billet mills, 5,000 tons.

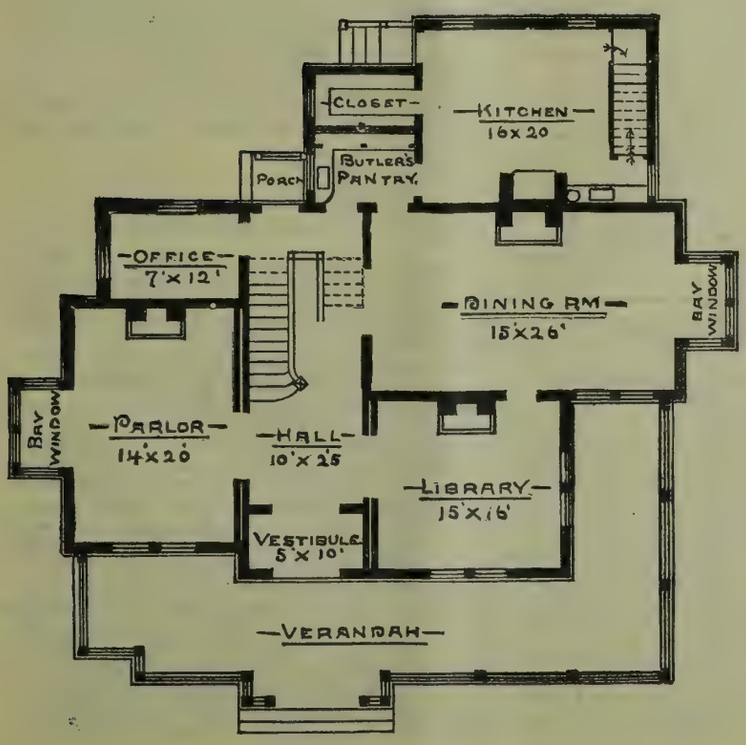
Design for a Suburban Residence.

Our architectural illustration this month is from designs of Mr. W. H. Beers, the well-known architect of 150 Broadway, New York, whose former productions in these columns will be remembered by our readers. Mr. Beers here presents to us a very beautiful design, striking in its originality. All details are so clearly brought out that it will not be necessary for us to point out the special features of the design, which must meet the reader's eye at a glance.

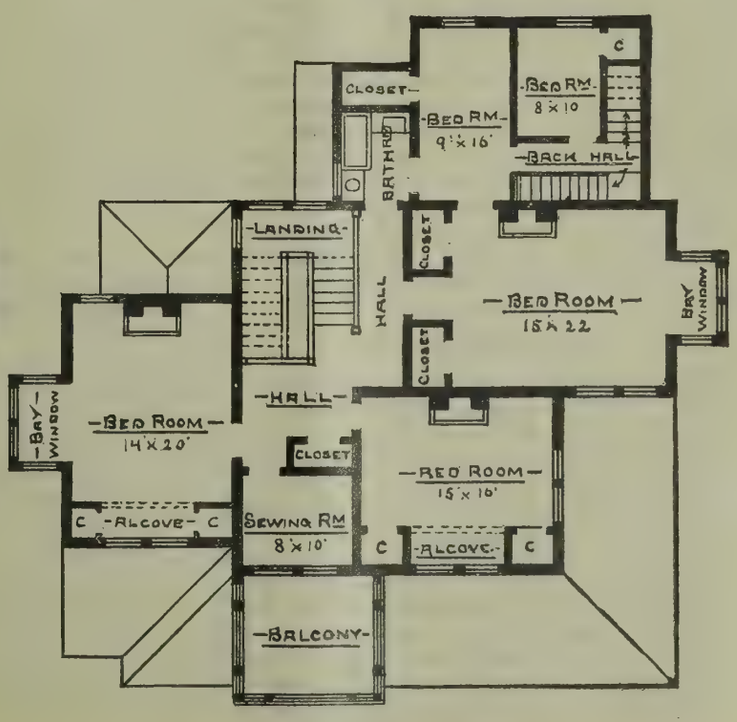
The arrangement of the floors will be particularly appreciated, presenting as they do both convenience and commodiousness. On the first floor there is a library, 15×16 feet; parlor, 14×20 feet; dining-room, 15×26 feet; kitchen, 16×20 feet; office, 7×12 feet; a wide verandah extends around the front of the house, and entrance from this into the house is from a vestibule 5×10 feet, leading into a hall 10×25 feet. On the second floor there are five bedrooms of the following respective dimensions: 15×16 feet; 14×20 feet; 15×22 feet; 9×16 feet; and 8×10 feet. On this floor there is also a sewing-room 8×10 feet, while off this is a small balcony. There are bay-windows in the parlor and dining-room, and in the two principal bed-rooms.

The estimated cost of this house in the neighborhood of New York city is $8,500.

DESIGN FOR SUBURBAN RESIDENCE, COSTING $8,500.



Plan of First Story.



Plan of Second Story.

Paper from Wood.

The advent of wood pulp wrought a marked change in paper manufacture as soon as this material became known as a substitute, in part, for rags and other stock. It is admitted by nearly all the manufacturers and users of paper that a proper proportion of wood pulp is of great benefit to the sheet, both in giving it "body" and in adapting it for taking ink. A proportion of wood, practically determined, does not impair the strength of the paper, but adds to its value. Chemical wood pulp, while retaining the best fiber, costs double the price of ground pulp, which is now more generally used. Wood is certainly the cheapest of all paper stock, and is the easiest to convert into pulp.

Improvements in the manufacture of pulp, as well as in its application to paper making, are following one another in rapid succession, and at the rate of advancement for the last five years, we may soon expect to see a very respectable sheet of paper made from the natural stick of wood, and by a continuous process, in one establishment. But wood pulp has other uses aside from paper making. Already it has been transformed into barrels, casks, pails and other wooden ware, while boxes, cornices, picture frames and papier-mache articles are successfully made from this material in various parts of the country. In the West it is claimed that the use of weather boarding may be avoided by substituting a covering made of wood pulp, and it is said not only to operate to good advantage for this purpose, but also to work well for doors.

At first it was thought that nothing but poplar, or "popple," as it is sometimes called in New England, would answer for pulp, on account of the peculiar and desirable whiteness which this wood possesses; but to-day we see many other kinds in successful use. Buckeye has been adapted in the West to a considerable extent, and although it is not so strong as poplar, its fiber is very white. In New England, besides poplar, spruce, pine, chestnut, basswood, fir, hemlock and cedar have been found suitable for various kinds of paper. The difference between the resinous and non-resinous woods is very marked as regards this industry, the latter being adapted for white paper only, while the former serves well for colored.

The Allen machines are arranged to handle all kinds of wood with equal facility, though the different woods grind very differently on the same stones. Willow makes the longest fiber of any wood when thus ground; basswood comes next, and then poplar. Spruce grinds harder and firmer than the former wood. Hemlock, cedar and fir grind about alike, though hemlock is rather the freest in pulping. Maple is quite hard to grind, but its fiber is shorter than either spruce or pine. Birch is comparatively hard and grinds very short. Poplar and buckeye, when pulped, remain white for a long time, whereas the other woods change their color, birch turning pink, maple purple, and basswood reddish. The aggregate product of ground wood pulp in the United States at the present time is over 200 tons per day.

An Ebonite Thermometer.

A thermometer that will indicate the thousandth part of a degree Centigrade is promised us by M. Michelson, who has demonstrated the principle upon which his very sensitive instrument is constructed before the French Physical Society. He does not employ mercury or spirit for his thermometer, but something that expands still more in the presence of heat—namely, hardened rubber or ebonite. The instrument is in the form of a spring, which is made of platinum on one side and ebonite on the other, and as the latter dilates some ten times more than the former under heat, there is naturally exerted a rise and fall in force every time a rise and fall of temperature takes place. The force exerted is communicated to a delicate lever or arm, and this, reflecting a beam of light from a lamp, magnifies the force that has been developed, and renders the change easily readable to the eye. Edison, it may be remembered, employed rubber for a similar purpose.

CORRESPONDENCE.

The Lawson Steam Boiler Experiments.

To the Editor of the Manufacturer and Builder:

In your September number is published a communication signed "John McMurtry," claiming to be a criticism of Mr. Lawson's boiler tests and invention for preventing explosions, which, for mistatement of facts, either ignorantly or willfully, is rarely excelled.

In Mr. Lawson's boiler, two-thirds of the usual steam space is cut off from immediate contact with the water in the boiler, thus removing at least two-thirds of the danger from sudden condensation, and all the danger from sudden check to the passage of steam into the cylinder.

The intelligent and impartial witnesses to Mr. Lawson's tests, declare in their published report that the removal of the center of the diaphragm could not have materially weakened his boiler, and that it showed less strain at 300 pounds pressure with all the concussion that could be effected, than the ordinary boilers of the same size and strength of material experimented upon at 150 pounds. And they also declare that concussion *cannot* be effected in the Lawson boiler.

The Lawson boiler is now in successful use, with rapidly increasing demand, and has given the highest possible satisfaction to those using it.

Now, a brief word as to Mr. John McMurtry. I learn from his own letters, with which he bored Mr. Lawson, that he tried to get the *Scientific American* to publish his papers on his theory of boiler explosions, and his sheet-iron plan remedy; but his articles were rejected by that journal six years ago, and last fall he succeeded, by dint of perseverence, in getting the veritable rejected communications inserted in the *Railway Age*, with which he accompanies his correspondence as a certificate of his importance. He bored Mr. Lawson with his *latent heat* delusion, till he, after finding it availed nothing to try to enlighten him, informed him as politely as possible that he could waste no more time with his correspondence. He then commenced addressing abusive letters to Mr. Lawson, which have received no attention.

Mr. Lawson is a gentleman of large information and scholarly attainments; and in the specialty of steam boiler explosions, which he has made a life study, it is the conviction of all who know him, and understand the philosophy of steam, that in this connection he has no compeer. Having been acquainted with this inventor for many years, I do not hesitate to come forward to any defence of his successfully tried theory, which to me stands preëminently at the head of the list of the great inventions of the age.

J. Wiggins.

Wellsville, O., October 22, 1882.

New Publications.

Spiritual, or Magnetic Forces. By Charles Holland, Ph.D., etc. Second Edition. New York: Asa K. Butts. 1882.

This work, from the inspection we have been able to give it, appears to be a plea for what, for want of a better definition, may be called a refined form of spiritualism, freed from the grossness of what ordinarily passes under that name. The author believes that a great "spiritual" force pervades nature, ourselves included, and this he somehow seeks to identify, at least in quality, with the magnetic or electrical forces. He believes in personal immortality, that departed spirits are in constant communication with the living, and narrates a number of remarkable stories (very much after the style of those of Robert Dale Owen in his "Foot-Falls"), such as the verification of dreams, of premonitions, etc., upon which he bases a presumed influence of spiritual force. When the author comes to discuss the lives and influence of the great founders of religious and philosophical systems, he becomes interesting, and even eloquent; and his chapter on Theology vs. Religion has much that we can endorse as sound and forcible. On the whole, we must regret that the author, while sound and sensible in much that he offers in his book, should in other things be so mentally befogged—or, shall we say, mentally diseased—as to delude himself on the strength of a few remarkable coincidences, with a figment of his own imagination.

The Gypsies. By Charles G. Leland. Boston: Houghton, Mifflin & Co. The Riverside Press. 1882.

The above work is from the pen of a well-known literateur, and contains many interesting sketches and descriptions of the life and character of this curious people, with whom the author affiliated at home and abroad. He has studied their language and mastered it, and this accomplishment he turns to good account in the interest of philology, since it insures his cordial reception as a brother among the wandering brotherhood and sisterhood wherever he may meet them. His sketches of these free and easy nomads make most interesting reading. The author is an enthusiast in his study of the gypsy character, and gives us in his charming sketches glimpses of the inner life of the strange people, that arouses sympathy, and occasionally admiration.

His chapter on "The Origin of the Gypsies," is one which seems to possess decided value as a contribution to this much debated subject. He claims to have discovered, by similarities in language, that this race of wanderers over the earth originally came from India. This portion of the work we must leave to the philologists to debate; but to all who are interested in learning something of the real life and character of the gypsies, Mr. Leland's book will be found most entertaining.

The Century Company, publishers of the *Century Magazine* and *St. Nicholas*, send us advance sheets of an article entitled "The Century Co.'s New Home," which will appear in the November issue of the *Century*. The article is admirably illustrated with views of the exterior and interior of the splended edifice on Union Square which will be the future home of the company.

The success which has been achieved by both of these excellent publications is remarkable; but it has been attained, not by reason of a happy stroke of fortune, but by solid merit. The *Century Magazine* has been in existence only twelve years, and at the present time has a circulation of 135,000 copies, of which at least 20,000 are sent to England. It has gained a leading place among the literary periodicals of the day, by the generally interesting, entertaining and valuable character of its articles and the excellence of its illustrations. In respect to this last, the publishers of the *Century* may be justly credited with having created a revolution in the matter of magazine illustration, by constantly elevating its character and compelling its rivals to follow. *St. Nicholas*, the children's magazine, is acknowledged by all to stand without an equal. The Century Company is to be congratulated upon its substantial and deserved prosperity.

A Supplement to Grimshaw on Saws. Containing additional Practical Matter more especially relating to the Forms of Saw Teeth for Special material and Conditions, and to the Behavior of Saws under Particular Conditions. By Robert Grimshaw. Philadelphia: E. Claxton & Co., 930 Market street. London: E. & F. N. Spon, 48 Charing Cross. 1882. Price, $2.

The supplement to this author's book on "Saws" is a useful addition to that well-known and valuable work. The supplement is confined more especially to the consideration of the varieties of saw blades and the forms of teeth for special materials and conditions. It contains many useful hints as to the care and management of saws. The supplement is finely printed on heavy plate paper, and is lavishly illustrated with engravings of the devices described. It is characterized by the terse and vigorous style for which all of this author's works are noted.

OTHER PUBLICATIONS RECEIVED.

Report of the Trustees of the Australian Museum, for 1881.

Prospectus of Oahspe. The New Bible, in the Words of Jehovah and his Angel Ambassadors. History of the Earth and her Heavens for Twenty-four Thousand years. Oahspe Publishing Association, New York and London. 1882, Anno Kosmon 34.

Quarterly Report of the Chief of the Bureau of Statistics, Treasury Department, Relative to the Imports, Exports, Immigration and Navigation of the United States for the three months ended March 31, 1882; also containing other Statistics relative to the Trade and Industry of the Country. Washington: Government Printing office. 1882.

Views of George W. Dean on the Defects of the present Tariff System, and the Remedy therefor, by a new amendment or section added to our Tariff Laws for Self-Adjusting Duties, to Prevent an Adverse Balance of Trade with other Nations, and its Disastrous Effects upon our Country.

Protection to Home Industry. Proceedings of the National Convention of Iron and Steel Manufacturers and Iron Ore Producers, at Cresson, Tuesday and Wednesday, September 12th and 13th, 1882. Philadelphia: The American Iron and Steel Association, No. 261 South Fourth street.

MANUFACTURERS' CATALOGUES RECEIVED.

Catalogue No. 10, November, 1882, of the Dean Bros. Steam Pump Works, Indianapolis, Ind. Thirty-two pages and cover. Profusely illustrated.

This department is intended to furnish, for the benefit of all our readers, information on any subject of a scientific or technical character falling within the field of THE MANUFACTURER AND BUILDER. *Any of our readers possessing additional or more correct information than that which we give relating to the questions, are cordially invited to communicate it to us for publication. We also request that all questions or answers be written on separate pieces of paper, and addressed to the Editor.*

QUESTIONS.

(3098) USING THE EARTH AS A BATTERY.—I have seen it stated somewhere, that the electric current circulating in the earth had been actually utilized in making an earth battery, with which articles could be plated with copper. silver, etc. Is this truth or fiction?—R. G., Santa Fé, N. M.

(3099) ELASTIC MOLDS.—What is the composition used for making elastic molds? and how is it used;—R. G., Santa Fé, N. M.

(3100) MAGNETIC AND ACOUSTIC FIGURES.—What would be the best method of showing the magnetic and acoustic curves and figures to an audience?—J. E. B., Hagerstown, Md.

(3101) PHOTOMETRIC UNITS.—What is meant by the expression "carcels" in connection with the value of an electric light? I met with it in what purported to be a translation from a French journal.—L. J., Worcester, Mass.

(3102) CASTS OF INSECTS, ETC.—Can you describe the method used for taking casts of insects, reptiles, etc.? I am informed that it is successfully done.—R. G., Santa Fé, N. M.

(3103) PHILADELPHIA CABLE RAILWAY.—Referring to your statement that a line of cable railway is being laid down in Philadelphia, will you please state some details of the cable and the mechanism for operating it.—W. B. L., Philadelphia.

(3104) DO WATER WHEELS RUN FASTER AT NIGHT THAN BY DAY?—I have often wanted to ask you if the belief of many practical mill men is true, that water wheels run faster by night than by day?—W. M. H., Lansing, Mich.

(3105) DUTY OF ENGINES.—I am about enlarging my establishment, and will need more power. I have used for some years a horizontal engine of plain slide valve pattern, and think of introducing an automatic engine. Can you recommend one?—J. M. R., Montrose, Pa.

(3106) KNOCKING, OR POUNDING, IN STEAM ENGINES.—What is the cause, or causes, of pounding in a steam engine? How can the fault be corrected?—H. D., Trenton, N. J.

(3107) ELECTRICITY IN METALLURGY.—Has the electric current been applied, as yet, successfully to precipitating metals (like copper) on the large scale in metallurgical works? If so, can you give me the facts, or refer me to some source of information?—C. S., Nashville, Tenn.

(3108) RUST STAINS ON WASHED LINEN.—My wife is distressed at the appearance of rusty spots on the household linen after washing, which were not visible before. She cannot devine the cause, and having seen a number of curious and mysterious problems solved in your Query column, she has induced me to write to you about it.—D. R. VAN N., Glen's Falls, N. Y.

(3109) ESTIMATING DISTANCE BY SOUND.—I have been told that one could estimate very correctly the distance of anything by the length of time it takes sounds from it to travel to the person. How is this calculation made?—P. S., Woodburg, N. J.

(3110) TO FIND THE NUMBER OF REVOLUTIONS OF A DRIVEN PULLEY.—I want a rule to give the number of turns of a pulley 6 inches diameter, driven from a fly-wheel of a portable engine, whose diameter is 48 inches, and runs about 100 turns per minute.—G. W. S., Friedensville, Pa.

(3111) METER FOR ELECTRIC LIGHT CONSUMERS.—Will you inform me, please, what sort of meter Mr. Edison employs to register the electric current used by the consumer. I believe it is done by the deposition of copper, but how I am unable to learn. An answer in your Notes and Queries column will oblige.—J. N. E., New York City.

(3112) APPLICATION TO BRICK WALLS TO KEEP OUT DAMPNESS.—There is offered for sale an article called "fluid flint," a transparent, water-like liquid, for applying with a brush to outside brick walls, to keep out dampness. It was used four years ago with entire success on an exposed wall near my home. You will greatly oblige if you can tell me where it may be had.—R. M., Philadelphia, Pa.

(3113) RESTORING FADED BLUES.—Is there any way of restoring faded blue color on flannels? Some stuff of this color, which was warranted to be fast—a bright blue originally—faded out in one washing.—D. R. VAN N., Glen's Falls, N. Y.

(3114) OR-MOLU.—What is the composition of the metal called "or-molu?"—B. F. M., Decatur, Ill.

(3115) PHAROAH'S SERPENTS.—How are the chemical toys called "Pharoah's serpents" made?—C. H. F., Wilmington, N. C.

(3116) TO POLISH BULLOCKS' HORNS.—How are bullocks' horns best polished?—B. T., Lawrence, Kan.

(3117) CIRCULAR SAWS FOR IRON.—What is the best size and shape of saw tooth, and the proper speed of saw, for cutting off hot or cold iron?—C. E. R., Allegheny City, Pa.

REPLIES.

(3098) USING THE EARTH AS A BATTERY.—The statement of this inquirer is quite correct. The earth has been used as a battery in the manner named by him, as the following facts from Napier's "Manual of Electro-Metallurgy" will testify: In the early history of electro-metallurgy, the art became very popular, and all who were working at it, whether for profit or amusement, were eager to find out some improvement in the operation, either for cheapening the process or simplifying the manipulation; so that when it was found that a piece of copper and a piece of zinc, imbedded in the earth and connected by a wire, gave a current of electricity in the same way as if they were placed in any battery trough, the fact instantly suggested the application of the earth in this way, as a battery, for the purposes of depositing. We remember of an offer made to a manufacturing electro-metallurgist of an exclusive right to work this form of battery for their depositions; and the principle of the battery insisted upon by the patentee, was that there were constant currents of electricity passing through the earth, and by burying a sheet of copper and a sheet of zinc a few feet apart, and connecting them by a wire, which, being a better conductor than the earth, the natural current was induced to pass through it, thus giving an inexhaustible supply of electricity. The idea was so attractive to the party negotiating for the patent-right, that nothing less than a series of experiments with large sheets of copper and zinc in different fields and localities, would satisfy them. We need hardly say that these trials were without success. The electricity obtained in this way is very weak, depending wholly upon the moisture of the earth, and is simply a water battery. It would be unnecessary to enter into details of our trials with large and small sheets of zinc and copper, and these placed at distances of from a few inches to hundreds of feet apart, further than to say that we made electrotypes by this means, and also plated small articles with silver, but the action or deposition was very slow. We obtained a greater amount of deposition in five minutes from one square inch of zinc and copper placed in dilute sulphuric acid than from four feet of zinc and copper placed in the earth for the space of an hour. An earth battery adapted to deposit from 150 to 200 ounces of silver per day, would require acres of land and tons of zinc and copper for batteries. In this, as in all other forms of battery, the deposit is in relation to the zinc oxidized in the battery; there would, therefore, be no economy in using the earth battery in single pairs, and to use an intensity arrangement would add to the expense, as it would require upwards of 100 pairs thus arranged in the earth to be equal to three or four pairs of the same size of Wollaston's for the object of depositing, and would thus be adding to the cost of depositing one hundred times the equivalent of zinc instead of four times its equivalent. The results of these experiments, we think, fully answer this inquiry.

(3099) ELASTIC MOLDS.—The composition used for this purpose varies somewhat, but one of the standard receipts for its preparation is a mixture of glue and molasses. To make it, 12 pounds of glue are steeped in as much water as will cover it for several hours. This is placed best in a metallic vessel, which is in turn placed upon a water bath, which last is kept boiling until the glue is reduced to the liquid state. When this occurs, 3 pounds of molasses are added, and the whole is well mixed by stirring. The method of using it is described as follows: Suppose that the mold of a small bust is wanted. A cylindrical vessel is chosen, so deep that the bust may stand in it an inch or so under the edge. The inside of this vessel is oiled, a piece of stout paper is pasted on the bottom of the bust to prevent the fluid mixture from entering the inside, and if it is composed of plaster, it is weighted with sand to prevent it from swimming. It is next completely drenched in oil, and placed upright in the vessel. This done, the melted mixture of glue and molasses is poured in till the bust is covered to the depth of an inch. The whole must stand for at least twenty-four hours, till it is perfectly cool throughout, after which it is taken out by inverting the vessel upon a table, when, of course, the bottom of the bust is presented bare. The mold is now cut with a sharp knife from the bottom up the back of the bust to the front of the head. It is next held open by the operator, when an assistant lifts out the bust, and the mold is allowed to reclose. A piece of brown paper is tied around it to keep it firm. The operator has now a complete mold of the bust in one piece, but he cannot treat it like a wax mold, as its substance is soluble in water, and would be destroyed if put into the solution. A mixture of wax and rosin, with occasionally a little suet, is melted and allowed to stand till it is on the point of setting, when it is poured carefully into the mold and left to cool. The mold is then untied and opened up as before, the wax bust is taken out, and the mold may be tied up for other casts. Besides wax and rosin, there are several other mixtures used. The object to be accomplished is to get a mixture that takes a good cast and becomes solid at a temperature below that which would melt the mold.

(3100) MAGNETIC AND ACOUSTIC FIGURES.—A simple plan of showing the magnetic and acoustic figures spoken of by this inquirer, would be to use a bracket for holding a glass plate of suitable size attached to the vertical lantern described on page 205 of our September number. The plate is clamped by means of two thumb-screws, and the bracket should be preferably made to swing out and in, so that the figures and curves could be produced, if desired, out of the range of the lantern, and the plate then swung in place. For the magnetic figures this arrangement would be very convenient. Another plan, which, if the inquirer does not care to show the figures in the act of being formed, better than that above described, is the following: Coat a series of glass plates with a thin layer of varnish; then produce the figures and curves, magnetic or acoustic, in the usual manner, and when formed satisfactorily pass a heated body (a sad-iron will answer) over the plate, and close enough to soften the varnish. The grains of sand or the iron filings of the figures will embed themselves in the varnish, and when this is cooled they will be firmly fixed in place. The plate can then be cut to dimensions, covered with another glass to protect the figures from rubbing, and used now as a lantern slide. Many of these figures are difficult to produce when desired, and hence this last method has advantages over the other, for a large number of curious figures may be thus collected, and will serve for permanent use. We have seen magnetic curves of very remarkable character made and fixed in the manner above described, by Prof. A. M. Mayer, which answered admirably for illustrative purposes.

(3101) PHOTOMETRIC UNITS.—The "carcel" is the French photometric unit, as the "standard candle" is that of Great Britain and the United States. The following will explain the difference and defines each: The English unit, or Parliamentary standard, for the estimation of the intensity of light, is a spermaceti candle, six to the pound, burning 120 grains to the hour. The French standard is the carcel, a lamp burning 42 grammes of refined colza oil per hour, with a flame 40 millimeters high, and is the equivalent of 9.5 candles. The English standard for gaslights is an argand burner with 16 holes, provided with a chimney 5 inches high and 2 inches in diameter, burning 5 feet of standard gas per hour, and giving a light equal to 16 candles. The German standard, or *Vereinskerze*, is a paraffin candle, 20 millimeters in diameter, with a flame 5 centimeters high, 7.6 of which equal a carcel, or of which 1 equals 1.25 candles of the English standard. Of these standards, the carcel is the most accurate as a standard of photometric measurement, as its variations rarely exceed 2 or 3 per cent, while those of the standard candles often rise to 30 per cent.

(3102) CASTS OF INSECTS, ETC.—Imbed the subject in a mold made of four parts of plaster of Paris, one of unburnt lime powder, and one of fine brick dust or coal ashes. Dry the mold carefully in an oven, then make it red-hot and burn the subject out of it, taking care to free the mold from the ashes. Before putting this mold into the oven to dry, insert two or more iron or smooth wooden pins, one end touching the object inside and the other projecting outside. When the mold is dried, and before burning, these are carefully withdrawn, to allow the escape of gas and to remove the ashes. By proper arrangement of these holes, the carbon of the article may be consumed, when the remaining ash is easily removed. Fusible metal may be cast in this mold, or a wax model may be taken of the object, pouring the wax in just before setting. The whole is now placed in water, the lime causes the mold to dissolve, or break up, and the figure modeled within it may be taken and covered with copper, and the wax afterwards melted out. Flowers, insects, lizards, and many other small living objects, may be put in metal in this way. In all of these operations a certain amount of skill is required, which will only be acquired by perseverance.

(3103) PHILADELPHIA CABLE RAILWAY.—The endless cable which pulls the cars along is made from crucible steel wire, and has six strands of nineteen wires each. Each wire is .062 inch in diameter, has a tensile strength of 160,000 pounds per square inch, and is capable of bending and knotting over itself without fracture. This rope, as has been explained, runs through the tubes or channels the entire length of the tunnel under one track, and at the Park terminus of the road, after winding half around a large horizontal sheave or wheel with grooves to hold the cable, it passes into the other tunnel under the other trackway, and, being thus directed into its new channel, runs on through and passes out at the eastern terminus to an engine room, where it winds several times about two winding sheaves, which are worked by two Porter-Allen engines of 100 horse-power each. Here is the motive power which drives the cable at the rate of six miles an hour. After being thus supplied with power, the cable passes around a horizontal sheave, which is run upon a tension carriage mounted on a track. Heavy weights are attached to the tension carriage, which draws it back as the rope slackens, preserving the same amount of tension on it at all times and keeping it

always taut. From the sheave on the tension the cable runs below into the tunnel under the first track, thus completing its circuit. The cable is always moving, and is supplied with sufficient power to haul all the cars of the line at one time at the rate of six miles an hour. In order to keep the cable always in line with the slot in the tunnel through which the shaft of the "grip" attachment comes down, and to prevent it from sagging down to the bottom of the tunnel, perpendicular guide wheels are fixed 32 feet apart in the center of the tubes, a few inches below the grip, into the grooves of which the rope falls, and is guided on its course when the grip does not hold it.

(3104) Do Water Wheels Run Faster at Night than by Day?—This question was answered in the negative in this journal, some years ago by our predecessor, and we are entirely satisfied of the correctness of that answer. The belief that water wheels run faster by night than by day, is based, like many other popular fallacies, on the flimsiest basis, which will not bear critical investigation. So obstinately is this belief entertained by many, that to satisfy them of the falsity of the belief, experiments have actually been made to settle the question. We give below the result of a test made by an experienced observer, and reported in the *Paper Trade Journal*. This experimenter used a very perfect apparatus for testing water wheels, and observed their performance for several days and nights. He made five experiments in the middle of the day, and three in the middle of the night, on a wheel 18 inches in diameter, running without resistance under a fall (H) of 8 and more feet running the wheel at 2,000 revolutions at each experiment, the time being calculated by noting the seconds for every 100 revolutions by a bell hammer attached to the wheel shaft. The following were the results of each experiment under the fall (H), which actuated the wheel, in revolutions per second. The revolutions are then reduced to what they would have been had the fall (H) been the same in every experiment, having one in each series, night and day, equal to 8.41 feet. R. is reduced to that H by the formula, as

$$\sqrt{H} : R = \sqrt{8.41} : R'$$

DAY EXPERIMENT.

H	*Revolutions.*	*H'*	*R'*
8.410 feet	4.901960	8.41 feet	4.90196
8.515 "	4.962230	8.41 "	4.93144
8.290 "	4.889975	8.41 "	4.92524
8.422 "	4.926108	8.41 "	4.92260
8.4216 "	4.950544	8.41 "	4.94713

Mean revolutions, 4.92569

NIGHT EXPERIMENTS.

H	*Revolutions.*	*H'*	*R'*
8.41 feet	4.88997	8.41 feet	4.88997
8.61 "	4.98753	8.41 "	4.93947
8.42 "	4.93827	8.41 "	4.93553

Mean revolutions, 4.92159; the temperature of the water being the same. On comparing the results of the two series of experiments, it will be seen that there is a slight difference in favor of the wheel's revolutions in the day. A careful test, such as this, is worth all the speculations that could be entered into by theorists whose minds are prejudiced in favor of one side, and who generally come to a conclusion before they commence to investigate.

(3105) Duty of Engines.—This inquirer will find several forms of automatic cut-off engines described in the back volumes of this journal, from which he will be able to draw his own inferences as to their suitableness for his needs. He is wise in having decided to introduce an improved engine, as his coal bill will very soon demonstrate to his satisfaction. Just how great the saving will be we will not pretend to say, but there is no doubt it will be sufficient to make a notable difference, as will appear from the following considerations. The best automatic engines (non-condensing) furnish 1 indicated horse-power for about 3 pounds of good coal, depending somewhat upon the fitness of the engine for the work and the quality of the coal. With a condenser attached, a consumption as low as 2 pounds may be quoted as good practice. The larger the engine the better the showing as compared with smaller engines. For ordinary slide valve engines, the coal burned per indicated horse-power will vary from 9 to 12 pounds; for the sake of illustration we will say 10 pounds, and that the engine is of such size as would require, for a year's use, $3,000 worth of coal. Now, an ordinary adjustable cut-off engine, with throttling governor, ought to save at least half that amount of coal, or say $1,500 per year. If the best automatic engine were employed, using 2½ pounds of coal per horse-power, a further saving of $750 per year could be effected; or, between the two extremes, $2,250 per year in saving of coal, without interfering in any way with the power, with the exception perhaps that the automatic engine will furnish a better power than the former engine. It is easy to see that it is true economy to buy the best engine and pay the extra cost of construction, if the saving of coal is an element (and it is generally the most important one) entering into the question of selection. The above considerations, which are given on the authority of Barr, a very careful and conservative writer on steam engineering, should leave no doubt in the mind of this inquirer as to the most prudent investment to make.

(3106) Knocking, or Pounding, in Steam Engines.—Nearly all writers on the steam engine give explanations of the cause of knocking, or pounding, in steam engines. Grimshaw, in his "Milling," gives the following very concise statement of the cause of the trouble. Lack of alignment causes knocking and pounding. With the Corliss type of frame, if the engine is properly aligned at first, it will not be likely to get out of line, except that the wear of the crank shaft bearing will cause the shaft to drop. The crank center line must stand true with the axle line of the cylinder when the crank is on the dead center. If the engine has a flat bed and adjustable guides, any error in the planing of the cylinder flange is magnified five times at the pall block, hence the cylinder must be so lined that the line through its axis will pass through the pillow block at the center of the bore of its brass. It must not be expected that a new engine will always start off right without any trouble. Bearings will bind, joints will leak, etc., and it takes a little time for everything to get to working nicely. Joshua Rose, a well-known writer on mechanical subjects, says that an efficient method of locating a "pound" in a steam engine is to place one end of a piece of ¼-inch wire, about 8 inches long, between the teeth, applying the other end to each end of the crank shaft, bearings, cylinders, etc., the violence of the shock in the vicinity of the pound being sufficiently pronounced to indicate its whereabouts. Mr. Rose remarks that all the mysterious "pounds" that annoy the engineer may be traced to a want of truth in the crank pin, or to an imperfect alignment of the main parts of the engine—usually the cylinder and main shaft.

(3107) Electricity in Metallurgy.—Keith, and others in this country, have devised methods for precipitating metals by electrolysis on the large scale, but we are not aware that these processes are in use commercially. Full details of these processes may be found in the *Engineering and Mining Journal* of some years ago. In Europe, we believe considerable success in this direction has been attained. Dr. Siemens, in his presidential address at the last meeting of the British Association for the Advancement of Science, refers to this subject in the following language: "The deposition of metals from their solutions is perhaps the oldest of all useful applications of the electric current, but it is only in very recent times that the dynamo current has been practically applied to the refining of copper and other metals, as now practiced at Birmingham and elsewhere, and upon an exceptionally large scale at Ocker, in Germany. The dynamo machine there employed was exhibited at the Paris Electrical Exhibition by Dr. Werner Siemens, its peculiar feature being that the conductors upon the rotating armature consisted of solid bars of copper 30 mm. square in section, which were found only just sufficient to transmit the large quantity of electricity of low tension necessary for this operation. One such machine, consuming 4 horse-power, deposits about 300 kilogrammes (660 pounds) of copper per 24 hours. The motive power at Ocker is derived from a waterfall.

(3108) Rust Stains on Washed Linen.—Rusty stains on washed linen may be caused by a variety of circumstances, but generally the cause is to be looked for in the use of the "soluble bluing" so much used to whiten clothes. These soluble blues are, in almost every instance, composed of a chemical compound containing iron, and known as "Prussian blue." This substance is decomposed by the fixed alkalies, soda (or potash), and if the clothes are not thoroughly rinsed to free them from soap suds or washing soda (if this has been used), the alkali left in the clothes will decompose the bluing and cause rusty stains to appear wherever the two may happen to adhere on the clothes in contact with each other; or it may cause the linen to take on a yellowish tint, which is often so aggravating to the painstaking housewife. To test the correctness of this explanation, we would offer the suggestion, in case it should prove that soluble blue has been used in washing the clothes, that it be discarded, and the old-fashioned indigo bag used in its place.

(3109) Estimating Distance by Sound.—This mode of approximating distances is a very handy one, and sufficiently accurate to be very useful in many cases. The calculation is very simple. Sound travels at the rate of 1,090 feet per second. Knowing this fact, it is easy to calculate the distance at which it was produced, in the following manner: Light travels with such inconceivable velocity (about 185,000 miles per second), that the flash or smoke accompanying the report of a gun may be considered to be seen simultaneously with the explosion. It is only necessary, therefore, to count the number of seconds that elapse between seeing the flash and hearing the sound, and to multiply this number by 1,090, in order to obtain a very close approximation to the distance at which the gun is discharged. In the same way the distance of a thunder-storm may be estimated. Thunder is the audible accompaniment of the lightning, and the two phenomena occur simultaneously. By observing the lightning flash, and noting the number of seconds before the report of the thunder is heard, the distance of the storm may be estimated in the same manner as above described.

(3110) To Find the Number of Revolutions of a Driven Pulley.—The following simple rule will solve the question propounded by this inquirer: Multiply the diameter of the pulley on the engine shaft, in inches, by the number of revolutions of the engine per minute. Divide this product by the diameter, in inches, of the pulley to be driven; the quotient will be the number of revolutions per minute. Applying this rule to the particular case stated by this inquirer, we would have the following result: Diameter of fly-wheel, 48 inches, multiplied by the number of revolutions of engine, 100=4,800. Dividing 4,800 by diameter of driven pulley; 4800÷6=800, the required answer.

(3111) Meter for Electric Light Consumers.—To the best of our knowledge, Mr. Edison employs a meter on the following principle: It is a balance, the pans of which are immersed in an electrolyte (sulphate of copper). The balance is introduced into the circuit, the pans forming the poles. When the current passes, metallic copper is deposited upon the surface of one of the pans. As this increases in weight, it descends. When it has descended to a certain regulated distance, the current is automatically reversed by changing poles, and the copper is dissolved from the pan on which it had been precipitated, and is deposited on the other, until it has descended, when the poles are again automatically reversed. These movements of the balance arms are made to record themselves upon a registering apparatus by simple mechanism, and from this the quantity of current consumed is ascertained.

(3112) Application to Brick Walls to Keep out Dampness.—We have never heard of the article called "fluid flint," which is named by this inquirer, as a material for keeping dampness out of brick walls. From its name, we have little doubt but that it is simply a solution of silicate of soda (or water glass). This can be procured at any of the large dealers in chemicals in Philadelphia, and an experiment with a small quantity would soon suffice to observe how well it answered the purpose. As commonly sold, silicate of soda is a thick, syrupy liquid. Before applying it, therefore, it will be necessary to thin it down considerably with water, that it may flow well and penetrate the bricks deeply. We have used and recommended silicate of soda for this purpose with success.

(3113) Restoring Faded Blues.—This question is difficult to answer, as we have no clue to the character of the dye employed. It is, however, known to be a fact that many of the bright blue flannels, and other fabrics at present very popular, owe their brilliant color to an acid compound of one of the coal tar colors, and as soon as they are washed in soap, the alkali neutralizes the acid and the color loses its brightness and becomes pale and faded in appearance. It has been found, however, that by adding some vinegar (acetic acid) to the second rinsing water, the bright color is at once restored. This fact is worth remembering. We do not wish to be understood as saying that all faded blues can be thus restored, for not all shades of blue are made with this compound. But the experiment is worth trying.

(3114) Or-Molu.—The or-molu of the brass founder, popularly known as an imitation of red-gold, and which is extensively used by the French workers in metals for artistic and decorative work, is composed of copper and zinc. A greater proportion of copper and less zinc is used in its preparation than in making ordinary brass. It can be readily cleansed with acid, and can be burnished with facility. To give this material a rich appearance, it is not infrequently brightened up after "dipping" (that is, cleaning in acid) by means of a scratch brush (a brush made of fine brass wire), the action of which helps to produce a brilliant gold-like surface. It is protected from tarnish by the application of lacquer.

(3115) Pharoah's Serpents.—To make the so-called "Pharoah's serpents," proceed as follows: Fuse in a crucible equal parts (by weight) of yellow prussiate of potash (ferrocyanide of potassium) and flowers of sulphur; frequently, it is advisable if the heat cannot be well regulated, to add a little carbonate of potassium. Lixiviate the mass with water and filter. The filtrate will be sulpho-cyanide of potassium, which, upon being added to a solution of mercury dissolved in nitric acid, gives a copious precipitate of sulpho-cyanide of mercury. This precipitate is then to be collected, washed well with water, and dried. When rolled into the form of a small pyramid, covered with tin foil and dried, it is ready for use. As this mixture gives off poisonous fumes, it is not prudent to ignite them in a close room.

(3116) To Polish Bullocks' Horns.—The following formula, from Spon, for polishing bullocks' horns, will be found to answer satisfactorily. 1. Scrape well with glass or a steel scraper, afterwards with finest glass-cloth, then with powdered bath-brick and oil, and finally with rotten-stone and flannel, or old cloth or felt hat. 2. First scrape with glass to take off any roughness, then grind some pumice stone to powder, and with a piece of cloth wetted and dipped in the powder rub them until a smooth face is obtained. Next polish with rotten-stone and linseed oil, and finish with dry flour and a piece of clean linen rag. The more rubbing with the stone and oil the better the polish.

(3117) Circular Saws for Iron.—We suppose that a toothed circular saw is intended. Grimshaw, in his work on "Saws" (second edition, page 171), recommends a 44-inch saw, ¼ inch thick, with peg teeth, ¾ inch space, the rim speed being about 15,000 feet per minute (which would correspond to about 1,300 turns per minute of a 44-inch saw). The plate to be made of very mild steel, not hardened or tempered. The same author recommends for *clean* cutting in *cold* metal, highly tempered saws with the cutting edge in a line with the center, and run at a low rate for steel and wrought iron (say 130 to 150 feet rim speed per minute). These last are best run in a solution of soap, oil and water.

THE MANUFACTURER AND BUILDER,

A PRACTICAL JOURNAL OF INDUSTRIAL PROGRESS.

Vol. XIV.—No. 12. DECEMBER, 1882. Fourteenth Year.

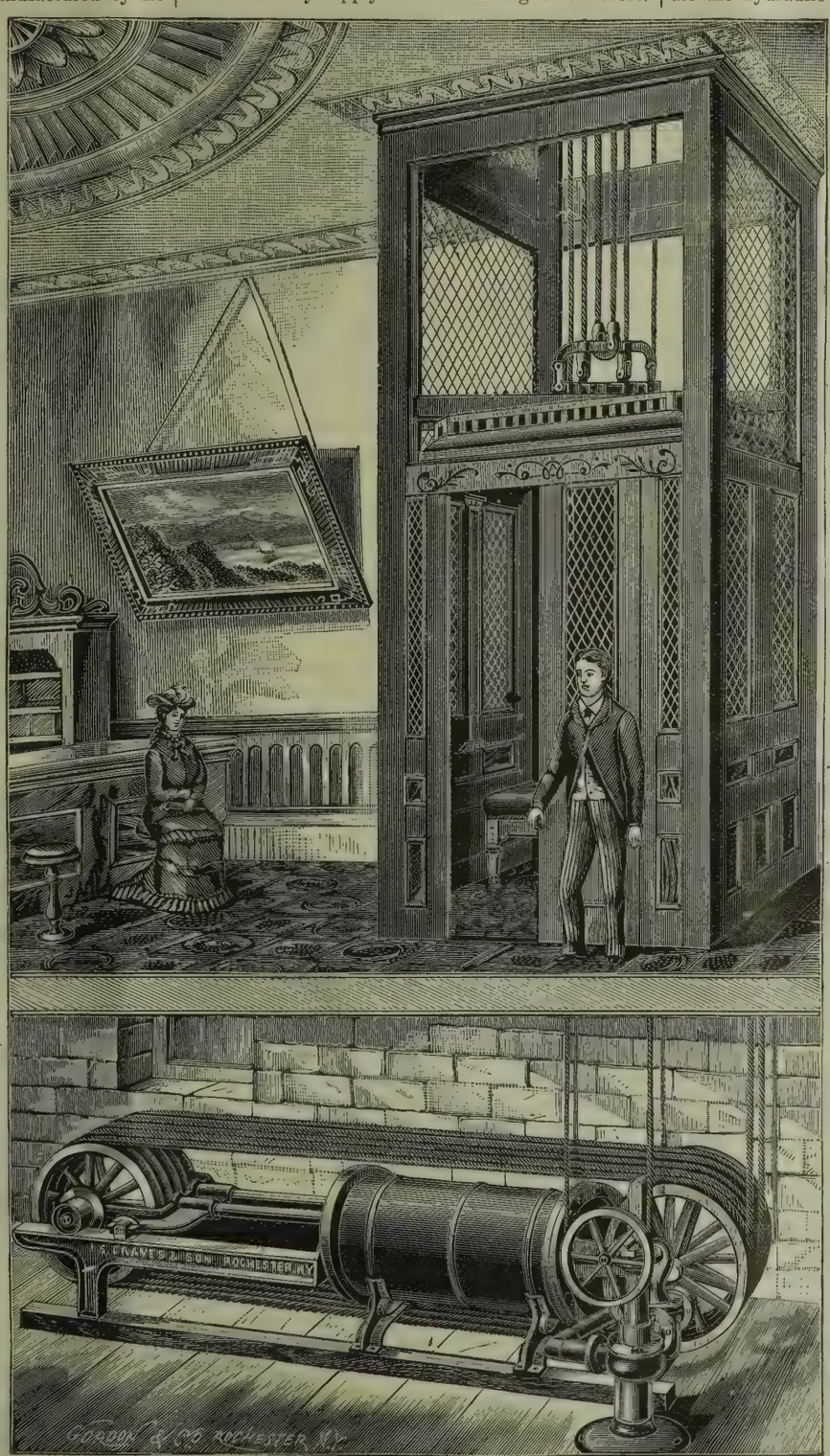
Hydraulic Elevators.

In inviting the attention of our readers to the special features of construction and operation that characterize the hydraulic elevator manufactured by the firm of L. S. Graves & Son, of Rochester, N. Y., we shall presume a full acquaintance on their part with the general principles respecting these indispensable appliances that we have repeatedly had occasion to set forth in previous articles relating thereto. As a discussion of such elementary principles involves a repetition of much that we have already given in detail, we will refer those who desire to have such elucidation to the back files of this journal, and proceed at once to the description of the characteristic features of the Graves hydraulic elevator, a representative machine of its class, which exhibits in its construction much that is worthy of commendation.

The firm above named is engaged in the manufacture of three types of elevators, a screw machine, and a geared machine, which will receive attention in our January issue, and the hydraulic machine which is the subject of the present article. The requirements of the service for which they are intended, and the conditions under which they are to be employed, will in each case determine which of the three types of machine will be the best adapted.

The makers recommend their hydraulic elevator for hotels, commercial buildings, dry-goods or clothing houses, etc., where the city or town is supplied with a system of water works at a pressure of from 25 to 100 pounds and the charges are not extravagant. Under such circumstances, the hydraulic elevator possesses many advantages over every other. Its first cost is considerably less, as it dispenses with the necessity of a steam boiler and engine, and does away, consequently, with the objections to a steam boiler in the building; annoying delays in waiting for steam, and no objectionable noise from the machinery; the cost of operating is considerably less than the cost of fuel and the services of an engineer where steam power is employed for the purpose of running the elevator alone, as is frequently the case; the machinery is very simple in action, not liable to derangement, and slow and noiseless in its movements.

Where there are no water works, or where the rates for the use of water are so high as to preclude the use of the city supply for the running of elevators, the tank system must be resorted to. In other words, a water tank of sufficient size is placed on the roof of the building, and another of similar size in the basement. Water from the upper tank is made to actuate the hydraulic engine, its pressure supplying the power to raise the car; in descending the water is discharged into the tank below, the rapidity of descent being controlled by the rapidity of the discharge of the water. Under such conditions, it is obvious that some exterior source of power must be employed to return the water to the upper tank as fast as it is used. This is generally accomplished by means of a steam pump, acting automatically, the introduction and use of which, as most large buildings are provided with steam power for other purposes, will not entail any notable expense.



THE GRAVES HYDRAULIC PASSENGER ELEVATOR.

Our illustration represents the hydraulic passenger elevator of these makers, with plain car and open hatchway. The motive power is shown below in the form of a hydraulic engine of the horizontal pattern, located in the basement or sub-cellar of the building, and receiving therefore the maximum pressure from any source of supply, whether from a tank on the roof or the city supply. The makers advance a number of arguments in favor of their adoption of the horizontal form of engine in preference to the vertical type, the chief of which are that they always obtain the greatest possible lifting capacity from the amount of water employed, and that they do away with the disadvantages incident to the extension of cylinders and other working parts up the whole length of the hatchway, which is necessary with the upright form of engine, and which requires a much larger opening for the same size of elevator.

The horizontal hydraulic engine seen in our engraving is provided with a continuous wire rope and sheaves, the number of which varies according to circumstances, and with a limited movement of piston can be made to raise or lower the car easily and noiselessly at any required rate of speed up to 250 feet per minute. In operation it is the inverse of the mechanical action of the common tackle block, the problem being to raise a comparatively

small load at moderate speed through a large space, by dividing the power among a number of sheaves.

The action of the water on the engine is governed by a hydraulic valve of peculiar construction, under the control of the attendant. To raise the car, the water is let into one end of the cylinder; this acts upon the piston, which is forced forward with its connection and cross-head, carrying one set of dividing sheaves. Upon a fixed shaft at the other end of the cylinder is another set of sheaves. The wire cables are attached to the cylinder rigidly, then passed over and under these two sets of wheels (as seen in the cut), then up to the top of the hatchway, over carrier wheels, and down to the car. When the engine is extended to its full length the car is at the top, the valve is closed, and the car is sustained at the top by the solid body of water which fills the cylinder. The action of the valve is reversed and the car descends fast or slow, in proportion as the water is discharged from the cylinder. The car is self-stopping at the bottom and top, by its own movement operating the shifting cable; but, as an absolute preventive of accidents, additional stops are put on the cylinder, which allow the piston to travel only the distance necessary for the total travel of the car. A water register is attached to the cross-head, which accurately measures the number of cubic feet or gallons used, according to the travel of the piston.

As regards the style and interior decoration of the passenger car, these are simple or elaborate, according as the taste of the purchaser may dictate.

The hydraulic system, in addition to satisfying the conditions of safety, combines likewise the advantages of smooth and noiseless running, starting and stopping, and the capacity of running fast or slow at the will of the operator, without any of the noise or other objectionable features of the steam machines.

From the foregoing our readers will have received a very fair idea of the character of these excellent machines, which have well sustained in practice the claims to excellence put forth in their behalf by the manufacturers.

The Manufacturer and Builder.

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This journal has the largest circulation of any mechanical monthly published in the United States. Its value as an advertising medium is therefore apparent.

Vol. XIV., No. 12. Fourteenth Year.

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Renewal of Subscriptions.

A large number of subscriptions to the MANUFACTURER AND BUILDER expire with the present issue, and we would request that subscribers send in their renewals promptly, so as to avoid any delay attendant upon receiving the ensuing numbers.

Something about Ourselves---Retrospective and Otherwise.

The close of another volume with the present issue gives us a fitting opportunity of saying a few words about ourselves, which we shall make brief and to the point. We have labored, and not entirely in vain as we have the best assurances for knowing, to maintain the leading position acquired by the MANUFACTURER AND BUILDER in the field of technical journalism, and wherever we have thought it possible to do so, to enhance its interest and value. Each monthly issue has contained numerous illustrated articles representing the progress of the mechanic arts in all departments. Each number has contained one or more valuable and artistic architectural designs from the hand of a noted architect; and our building news and market reports have been full and accurate. The scientific department will be found to embrace a *resumé* of scientific progress for the year, and a number of investigations of permanent value have been published with a wealth of illustration. The editorial department has been conducted so as to embrace the discussion of every leading subject of technical interest that has come into prominence during the year; and the department of "Notes and Queries" has been made quite as interesting and valuable to our readers as ever before.

The evidences of the continued popularity and usefulness of the MANUFACTURER AND BUILDER which are the most convincing and gratifying to us, are the steadily increasing circulation and the growing advertising patronage, to which we may refer with special satisfaction.

With the country at large settled down to what we believe to be a long career of solid business prosperity, we feel assured that by continuing to merit it we shall enjoy our full share. We shall, therefore, spare no effort within our power to make our journal indispensable to all who take an interest in science and the mechanic arts, and offer our kindest wishes to all our readers and patrons for a prosperous New Year, which we hope to share with them.

Census Inconsistencies.

The controversy that has recently sprung up between the officials in charge of the last census and Mr. Lorin Blodget, respecting the accuracy of the industrial census of Philadelphia, has had at least one good effect, in that it has brought to light a number of glaring inconsistencies that cannot be reconciled, and can only be reasonably explained on the assumption which we believe to be correct—that the machinery at the command of the government for this important work is quite inadequate for its proper performance. Leaving entirely out of consideration, as foreign to our purpose, the imputations of want of fairness, partisanship, and the like, which have been made with much earnestness, we think it will be apparent to any one who will carefully look at the enormous magnitude and importance of the work undertaken by the Census Bureau, that such work can only be properly performed by men qualified therefor by years of special training and study; and that the practice of placing the task of taking the manufacturing statistics of our great cities in the hands of men who are not thus qualified, whatever their eminence as professional or business men, can yield results of but little, if any, practical value. In this, as in many other branches of government work, the service of a thoroughly trained corps of officials, brought up in this service, and secure in their tenure of office, such as is contemplated in the scheme for reforming the civil service, is absolutely necessary to give reliability and value to the work. The most eminent qualifications in the hands of a bureau of this description avails but little when the material which they work up is gathered by hosts of incompetents at so much *per diem*. That the last census is in many respects the most inaccurate and unsatisfactory of any that has lately been taken, is now generally accepted to be a fact beyond dispute. It is even gravely announced, that, owing to want of intelligent supervision, and other causes, much statistical information designed for special reports, and collected at a cost to the people of many millions of dollars, cannot be made available.

It is well known to those who are at all familiar with the principles of statistical science, that there is a certain harmonious relation between the elements entering into the composition of any specific subject; that certain factors—for example, the capital invested, operatives employed, and value of manufactures, in any one branch of industry bear a certain definite relation to each other; and that knowing one of these factors, the experienced statistician will be able to predict to within a very close approximation what the others should be. Such being the case, these relations can be made to serve as a means of controlling the accuracy of alleged statistics.

If such a test is applied to the "Census Report of the Manufactures of Twenty Cities" lately issued by the Census Bureau, the inaccuracies and incongruities of the report appear at once. As examples, we will select but one or two illustrations of a number that have been pointed out by one of our contemporaries.

The average annual product of each person employed in eighteen cities, exclusive of New York and Philadelphia, is $2,860. If, now, a comparison be instituted as to the value of product per hand employed in the several cities, the following surprising divergence appears: In Jersey City, the average annual product per hand employed, is found to be $5,574; in Brooklyn, $3,751; in Chicago, $3,106; in New York, but $2,056; and in Philadelphia, but $1,752. Such glaring divergences in figures could only be possible in case the cities credited with such

excessively high figures were very largely engaged in manufactures of precious metals, jewelry, watches, costly laces, silks, velvets, and other elegant and costly articles of luxury. It is hardly necessary to add that such is not the case, and that no pretence is made that such is the case. Again, in the eighteen cities above referred to, the average yearly outcome of each dollar invested, according to the figures of the Census Bulletin is $2.53. Jersey City is credited with $5.25; Chicago, with $3.75; Brooklyn, with $3; New York, with $2.11; and Philadelphia, $1.07.

We need hardly say, in referring to the above figures, that a condition of things in which capital invested in manufactures should command such unequal returns could not exist, since the inexorable laws of competition in trade would infallibly extinguish it. Great inequalities in the distribution of certain classes of manufactures might explain temporary inequalities of this kind, but it is well known that such irregularities do not exist to any notable degree. It is, therefore, apparent that the figures of the Census Bureau, so far as they relate to the industrial census of our leading cities, will not stand the test of critical analysis.

A Rival (?) to the Electric Light!

To use the words of the foreign special correspondent of the *Industrial Review* (a commercial journal of considerable ability), "Edison must look to his laurels, for inventors seem determined that electricity shall not be the coming light unless it can overpower some strong opponents." This statement is made *apropos* of the description of a most extraordinary invention that follows, and which, as a specimen, will do well to place alongside of the jargon of the alchemists:

"It is well known that, under the influence of great heat, some chemical substances produce flames of peculiar colors, which, when blended, give a powerful white light. Taking advantage of this knowledge, Mr. John Dixon, a gas engineer at Liverpool, has invented a process for the production of gas for illuminating purposes, by the decomposition or dissolution of the component parts or constituents of metals, earths, acids, carbon and hydro-carbon substances, and the salts of acids. An apparatus has been invented capable of manufacturing and storing a gas, the result of the decomposition of sundry chemicals. The inventor claims to be able to supply a gas which, he says, is not only superior to, but vastly cheaper than, any supplied by other persons or companies in any part of the globe. Without sharing the enthusiasm of the inventor, or accepting his arithmetical conclusions, it is only mere justice to acknowledge the scientific success of Mr. Dixon's labors and experiments. He asserts that, whereas one thousand men will produce a given quantity of coal gas, three men under his system will obtain a like quantity of metallic gas which will give a superior light at least six times its intensity. For twelve months this new gas has been under trial, during which it has had to submit to a number of crucial tests which it has successfully borne. Neither time nor weather seems to affect it, and although it can easily be made to travel through the mains and pipes, yet there is no perceptible condensation of water. It has no smell in burning, and is remarkable for its cleanliness, for it has no sulphurous smell, vapor or smoke. Such is the invention, and for the advancement of it a limited-liability company has recently been formed, who are erecting works in Liverpool to carry on the manufacture upon a more extensive scale."

In reading the above, we hardly know which to admire most—the ingenuity of Mr. Dixon in making his claims broad enough to cover almost everything, or the credulity of a special correspondent who is innocent enough to send such rubbish across the ocean for the edification of American readers. England has the reputation of being the paradise of speculators, floaters of bubbles of every description, and we have no doubt that there is such a person as Mr. John Dixon, who has taken out some preposterous patent for gas-making, and has succeeded in forming a company to operate his patent. But it appears to us that one of the offices of a "special correspondent" of an industrial journal, is to expose just such charlatanry as this so-called process of Mr. Dixon unquestionably is. If this is a sample of the foreign industrial news that the *Industrial Review* proposes to serve up to its readers, we shall look for its coming with much interest, in the assurance that we shall be at least amused, if not instructed. But, seriously, we would advise our able and enterprising contemporary that its foreign special has made himself ridiculous.

A New Industry Established.

The establishment of a new and great industry upon a firm and profitable basis, in any country, is a positive addition to its wealth. As a representative of the manufacturing interests of the United States, and feeling the warmest interest in the growth and development of our industries, and especially in the domestication of new industries, the MANUFACTURER AND BUILDER can heartily rejoice with Mr. Lewis S. Ware (the eminent specialist who has done so much valuable pioneer work in preparing the way to the introduction of the beet sugar industry in the United States, through the medium of the *Sugar Beet*), that in one State at least the problem of the profitable manufacture of sugar from the beet has been successfully solved. We esteem this subject to be of such importance that we give space for a detailed statement in explanation, for the facts of which we are indebted to Mr. Ware's publication of an article on the "Alvarado Beet Sugar Company."

The Standard Sugar Refinery of Alvarado is a California enterprise, started some years ago, and the balance-sheet of the operations of the establishment for the third campaign, shows a profit to the company of $44,935.85, representing an interest of about 25 or 30 per cent upon the invested capital in one season's work. From all that we know of the subject, in which we have long taken a special interest, we feel satisfied there is no reason why factories, worked and managed like the Alvarado, should not be successfully at work in every State in the Union. It can hardly be expected that such great profits would be made in every case, but with scientific superintendance, which implies the intelligence to select and employ the most approved methods in vogue in the Old World, and the avoidance of the causes that led to failures in the earlier attempts to establish the industry here, there can be no excuse for failure now. The stumbling blocks in the past were partly the absence of the thorough technical training so indispensable in the proper management of this special industry, and partly the ingrained habit of American superintendents, and others interested, in attempting to improve upon the machinery and methods that are found successful in Europe.

There is no other great industry that can be said to be so entirely the product of scientific investigation as the manufacture of sugar from the beet, and none that calls for more thorough and special training in its successful conduct. It is not difficult to comprehend, therefore, why failure should have followed the attempts on the part of those who, with but superficial training, undertook to improve upon approved European models, and methods. A strict adherence to these cannot fail to secure success, while failure and financial disaster has invariably attended those who departed from them.

Referring again to the operations of the Alvarado company, we will add the following facts: Mr. Dyer, the superintendent, says, with respect to the works, that he finds it impossible to work as economically as though the entire establishment had been built in strict accordance with scientific principles. In the face, then, of the excellent showing above referred to, it would appear that if the establishment of the Alvarado company were provided with the most approved machinery, placed in a building adequate for the requirements, its profits for the third campaign would have been even greater.

The following details will, we are sure, be read with attention by all who are interested in this subject. The Alvarado company used 11,229 tons of beets in the third campaign, for which it paid $47,553, or $4.23 per ton. As the average yield to the acre was nearly 15 tons, the returns from the crop were $63.45 per acre, which evidently leaves a handsome profit to the tiller. Mr. Ware effectually disposes of the argument that beets cannot be profitably raised by our farmers, by showing from the foregoing figures that a beet crop, under proper auspices, is extremely profitable; in fact, with few exceptions, much more so than any other, especially the cereals.

We glean also the following additional facts from his article on the subject: "The sugar manufactured from the beet at the Alvarado factory sold at nearly 11 cents per pound, which figure gives evidence of its superior quality. The fact of 1,391,688 pounds of sugar having been obtained from 22,460,000 pounds of beets, shows that the average yield in high grade sugar was over 6 per cent; and if to this be added the crude sugar, we would have a yield of over 7 per cent—a most excellent result, which in itself far exceeds what was obtained in the greater number of European beet sugar factories some years since. We sincerely regret that the molasses cannot be utilized; the Alvarado company are selling it at 8½ cents a gallon, which practically means they are giving it away. If the various improved methods of osmose, etc., had been resorted to, they might have been made profitable, and the crude sugar then obtained would have amounted to over 8 per cent of the beets worked. It should not be forgotten that one pound of ordinary beet molasses contains a half pound of sugar which will not crystallize. The sugar can, by fermentation, be transformed into alcohol. If, for example, the 81,000 gallons of molasses had been fermented, distilled and rectified with improved apparatus, they would have yielded over 20,000 gallons of the very best alcohol; and if we admit a net profit of $1 per gallon, which is very low when the superior quality of the product is considered—that is, alcohol marking 96° B., there would have resulted a profit of $20,000. The surplus capital required for molasses distillation sufficiently large to use the resulting molasses for a 200-ton factory, would be about $40,000. The profit, consequently, would be nearly 50 per cent the first year; and besides alcohol, there would be potassa, etc., as residuary products.

"Our readers may notice that in the total receipts published above, no mention is made of the residual pulp being sold. This product evidently represented about 33 per cent of the total roots worked, or 3,740 tons; and if this had been disposed of at the same price as it was at Franklin and Delaware—namely, $1 per ton, its actual value for feeding purposes being nearly $3, the revenue from it would have been nearly $4,000, which should be added to the $50,000 before mentioned, giving a total profit of about $54,000."

In the face of this successful demonstration of the Alvarado company, it can no longer be doubted that nothing more than intelligent superintendence in the construction of works, and in their subsequent management, is required for the profitable establishment of the sugar beet industry in many of the States and territories of the Union. From all that we have been able to learn concerning the Alvarado factory, the circumstances surrounding its establishment and operation are not exceptionally favorable, as might perhaps be inferred from the large profit realized. On the contrary, it has arrived to its present successful status only after repeated alterations in its machinery, necessitated by faulty construction at the start.

The foregoing facts and statements, we believe, are worthy of the careful consideration of our enterpris-

ing capitalists. There is no field, in our judgment, in which investment, governed by intelligence, promises more abundant returns. There is room for five hundred beet sugar factories in the States to supply our home demand.

Improved Domestic Sanitary Appliances.

We illustrate and describe herewith some representative specimens of a very superior class of domestic sanitary appliances and conveniences, which are manufactured exclusively for the J. L. Mott Iron Works, of this city, by Messrs. Joseph Cliff & Sons, England. We have repeatedly had occasion to invite the attention of our readers to the high rank occupied by this well-known house as manufacturers of highly artistic iron work of every description for domestic uses, and the appliances we are about to describe, which are the latest additions to their already large and comprehensive sanitary department, fully maintain its high reputation, being in many respects superior to anything of a similar kind that we have thus far seen.

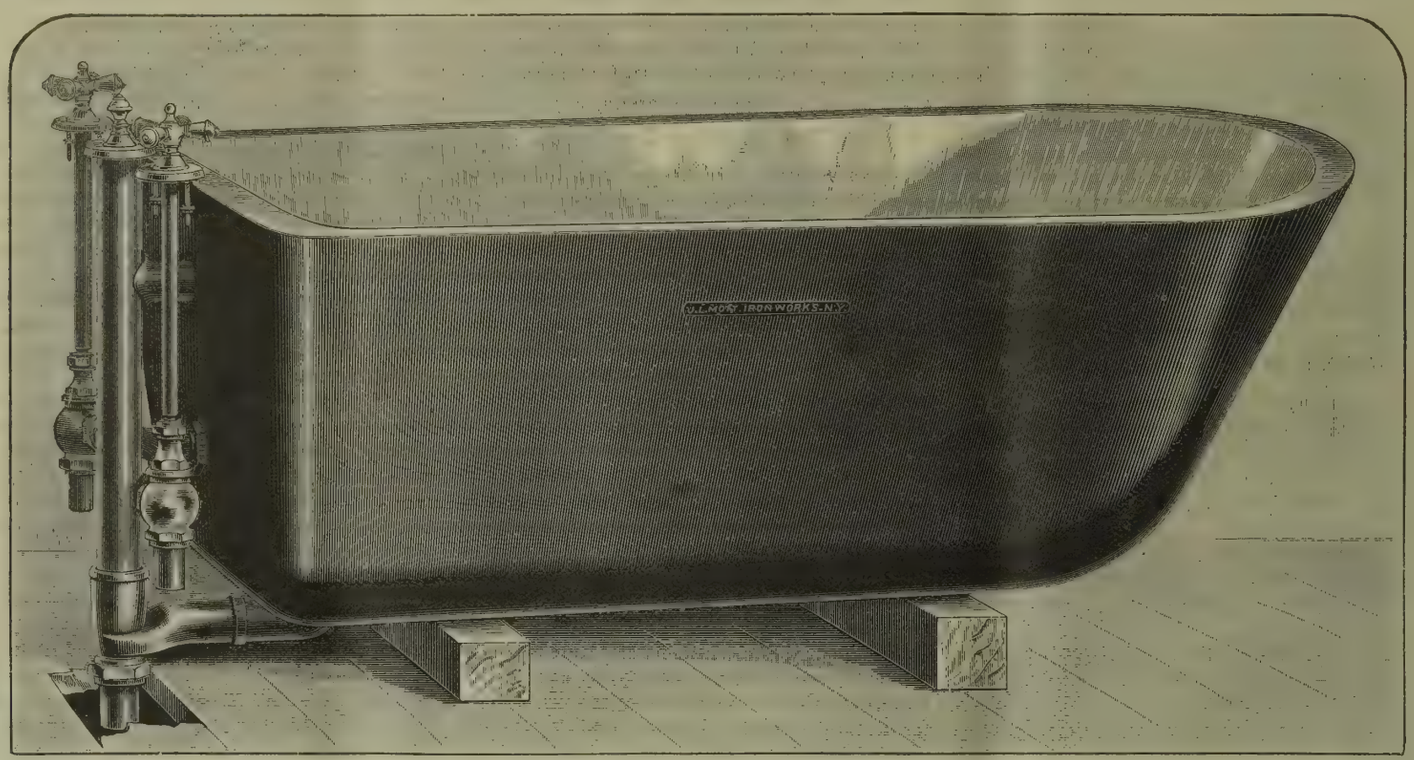


Fig. 1.—"IMPERIAL" PORCELAIN BATH TUB.

Fig. 1 represents a perspective view of the very appropriately named "Imperial" porcelain bath. This bath is molded and glazed in one piece. The glazing is delicate and uniform in color, and very perfectly executed, which, considering the size of the article and the great difficulty of securing perfect work of this kind, is something quite remarkable. Aside from the artistic excellence of these baths, the fact that they are very much lighter than anything of the kind thus far manufactured, is another very desirable quality, as it not only does away with the appearance of clumsiness, but saves freight in shipment, and enables the plumber to handle and put them in place with comparative ease. Incidentally, too, they place less strain on the floor beams, which may occasionally be of advantage.

The porcelain bath tub, being absolutely non-absorbent of moisture, being likewise practically unalterable by atmospheric agencies, oxidation, etc., which speedily affect wood, zinc and other metallic surfaces, is obviously superior to these in respect to cleanliness and durability. In regard to the former qualification, which is of vital importance from a sanitary standpoint, no surface can compare with that of smooth glazed porcelain. It entails no labor in scouring or burnishing, requiring only to be wiped out with a sponge to be made perfectly clean. The fixtures are of brass, nickel (or silver) plated, and are of the most approved order. An important feature attached to these baths is the McFarland waste, a most effective, durable and simple attachment, dispensing entirely with the usual overflow pipe. The hot and cold water supply mingle before entering the bath, the temperature being regulated at pleasure by turning one or the other, as may be necessary. The Figs. 2 and 3, showing a top view of wood casing, give the exact proportions of the openings of the two sizes of these baths manufactured, and of the dimensions of the top wood-work, which, in case of necessity, may be reduced. The dimensions of bath (both sizes) are as follows: No. A, (inside dimensions), length, 62 inches; width (top), 26 inches; depth, 20¾ inches; weight, 520 pounds. No. B, (inside dimensions), length, 52 inches; width (top), 24 inches; depth, 20 inches; weight, 430 pounds; thickness of baths, 1¾ inches.

Fig. 4 represents another example of the same superior class of domestic appliances—namely, the Imperial porcelain wash tubs, which are made to set up with or without covers, etc., as may be desired, and which have, as compared with wood or sheet metal articles of similar kind, the same advantages as regards appearance, cleanliness and durability that have been named in connection with the bath tubs. Our illustration shows the Imperial porcelain wash tubs set up without covers and with faucets over the top, an arrangement which is to be preferred, as it gives more room inside and admits of a much better arrangement of the supply pipes, as these may be placed over the tubs instead of behind them, thus making them more readily accessible for repairs in case of leakage, etc. A sliding cover may be made for them if desired, but they look better without it—showing the clean porcelain surface.

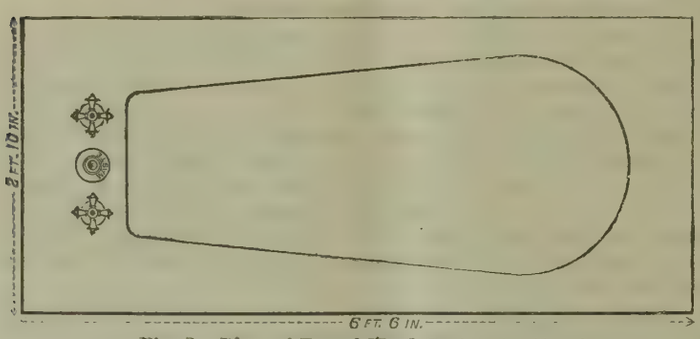


Fig. 2.—Plan of Top of Wood Casing for No. A

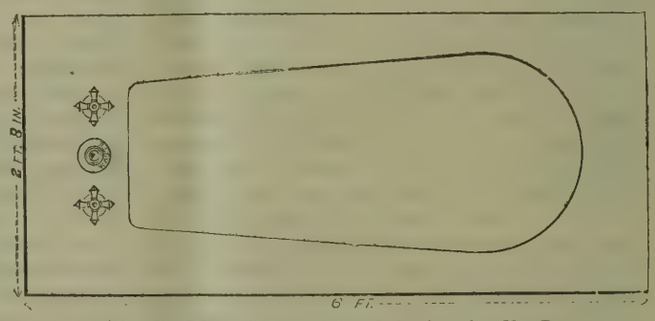


Fig. 3.—Plan of Top of Wood Casing for No. B.

For further information respecting these admirable domestic appliances, we refer our readers to the J. L. Mott Iron Works, 88 and 90 Beekman street, New York.

Close of the New England Fair.

The New England Manufacturers' and Mechanics' Institute Fair closed November 18th, after a very successful season, the managers having with the proceeds wiped out a debt of $25,000, paid all expenses, and secured a balance. Preparations are already being

made for the exhibition of 1883, which will be an inter-sectional one, at which it is proposed to compare, on a large scale, the products of the South with those of the North. The Legislatures of thirteen Southern and Southwestern states have been memorialized to furnish appropriations to secure state exhibits. A large number of individual applications for space from Southern states have already been received.

A New Fire-Proofing Material.

A test of a new fire-proofing material, which is intended to take the place of iron beams in constructing fire-proof buildings, took place recently in this city, at Schillinger's stone yard, at Ninety-second street and Avenue A. The material consists of coal ashes and plaster of Paris molded into strips 1½ inches thick. A large oven built of this combination was erected in the yard. The top of the oven was coated with the fire-proofing, so as to represent the ceiling of a room; above this were placed a number of wooden beams, and around the latter were nailed strips of the same material, the whole being surmounted by a wooden floor. Fire was started in the oven and allowed to burn fiercely for an hour and a half. The fire was then extinguished with water, and it was found that the floor was scarcely warm, while a beam that was directly across the flue was only slightly charred, and a very small piece of the ceiling of the oven had fallen. It is claimed that iron beams would not have stood so severe a test in such a satisfactory manner, and that the cost of this method of fire-proofing will be about 33 per cent of that now employed.

Edge Tools.

All cutting and piercing edge tools operate on the principle of the wedge. A brad awl furnishes an example which all can readily understand. The cutting edge of the awl severs the fibers of wood as the instrument enters, and the particles are compressed into a smaller compass, in the same manner as when a piece of wood is separated by a wedge. A chisel is a wedge in one sense; and an ax, drawing-knife or jack-knife is also a wedge. When a keen-edged razor is made to clip a hair or to remove a man's beard, it operates on the principle of the wedge.

Every intelligent mechanic understands that when a wedge is dressed out smoothly, it may be driven in with much less force than if its surface were left jagged and rough. The same idea holds good with respect to edge tools. If the cutting edge be ground and whet to as fine an edge as may be practicable with a fine gritted whet-stone, and if the surface back of the cutting edge be ground smooth and true, and polished neatly, so that one can discern the color of his eyes by means of the polished surface, the tool will enter whatever is to be cut by the application of much less force than if the surfaces were left as rough as they usually are when the tool leaves the grind-stone. All edge tools, such as axes, chisels and planes, that are operated with a *crushing* instead of a *drawing* stroke, should be polished neatly clear to the cutting edge, to facilitate their entrance into the substance to be cut.

The Transit of Venus.

The most important astronomical event of the century occurs on Wednesday, December 6th, on which day the planet Venus crosses the disk of the sun. The importance of this event to the world of science will be understood when we explain that by means of accurate observations of this occurrence, it will be possible to fix with greater precision than has hitherto been possible, the value of the solar parallax, by which the sun's distance from the earth may then be determined with greater accuracy. The earth's distance from the sun is the base line for all celestial measurement, and upon its accuracy depends the value of many of the most interesting and important conclusions respecting the distance and movements of the heavenly bodies. The event is, therefore, justly regarded by astronomers of all nations as of paramount importance, and numerous expeditions, sent out at great expense by the governments of nearly all civilized countries, and equipped with the most refined instruments of precision, will take a multitude of observations of the interesting phenomenon. The importance of the event is hightened by the fact that a century and a quarter will elapse before astronomers will have another opportunity of observing it again, as the next transit will not take place until the year 2004.

The scientific value of this occurrence as a means of accurately calculating the sun's distance was first pointed out by the astronomer Halley, but owing to the imperfections of astronomical instruments, the value of 8.57″, assigned by Encke for the solar parallax in 1824, from the observations made of the transit of 1769, is believed to be too small, and the generally accepted distance of the sun—95,000,000 miles—which is based upon it, too large. The results of the observations of the transit of 1874 are not yet available, as the calculations and comparison of the work of several hundred observers involves an immense amount of labor; the indications, however, from portions of the work that are already completed, point to the true value of the sun's parallax as being somewhere between 8.79″ and 8.83″.

This reference to the subject of the transit of December 6th is written before the date of its occurrence, and we can only hope, with the whole scientific world, that the observers will be favored with perfect weather.

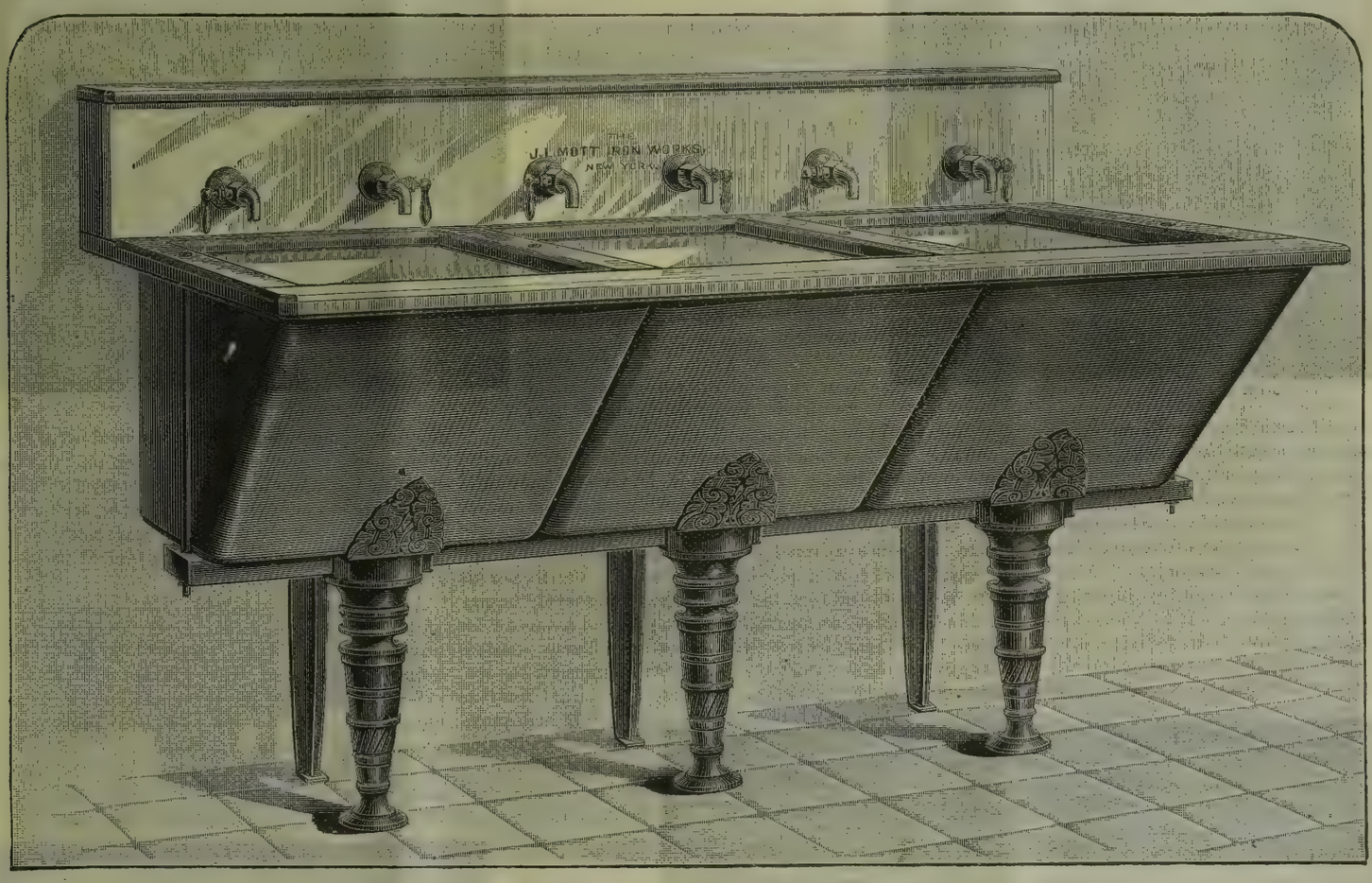


Fig. 4.—"IMPERIAL" PORCELAIN WASH TUB.

A New Use for Glass has recently been developed in its substitution for marble for tops of tables and dressing-cases. A Pittsburgh firm has turned out slabs of glass which are said to be a perfect imitation of marble, while the material allows a variation into decorations of novel design, both in form and color. The success of the new idea will, however, depend more upon the caprices of fashion than actual commercial principles.

Recent Improvements in Wood-Working Machinery.

Fig. 1 represents a band-sawing machine, invented and patented by Hector Aylesbury, of Bristol, England. The following points are claimed as novel: 1. In a band-saw machine having two band-saws and two pulleys on one shaft, by which the saws are

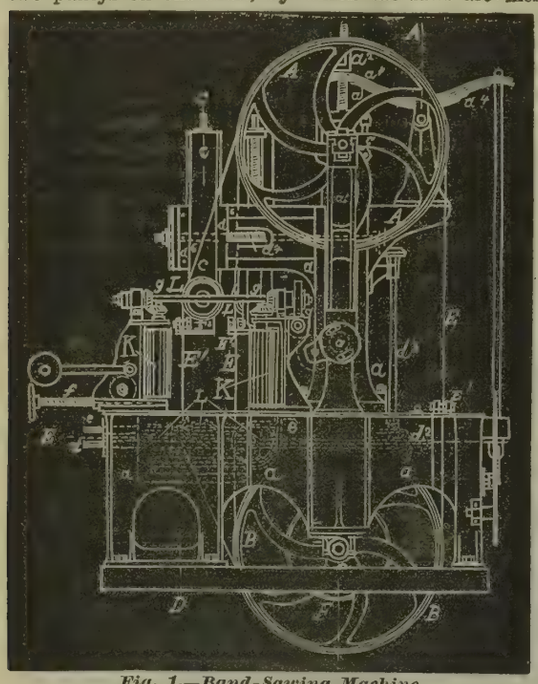


Fig. 1.—Band-Sawing Machine.

driven, in combination with two separate pulleys and shafts and adjustable bearings for the same, and distending pulleys for the saws, whereby two cuts can be made simultaneously, either parallel or at a bevel. 2. In a sawing machine, the two band saws E E′, the pulleys B B′, and the driving-shaft for the same, in combination with the pulleys A A′ and their separate shafts C C′, elastically adjusting bearings, the distending pulleys L L′ L^2 L^3, mechanism for simultaneously adjusting the pulleys L L′, feed rollers K K′, and fences K^3, and mechanism for adjusting the same, whereby the two cuts are made simultaneously,

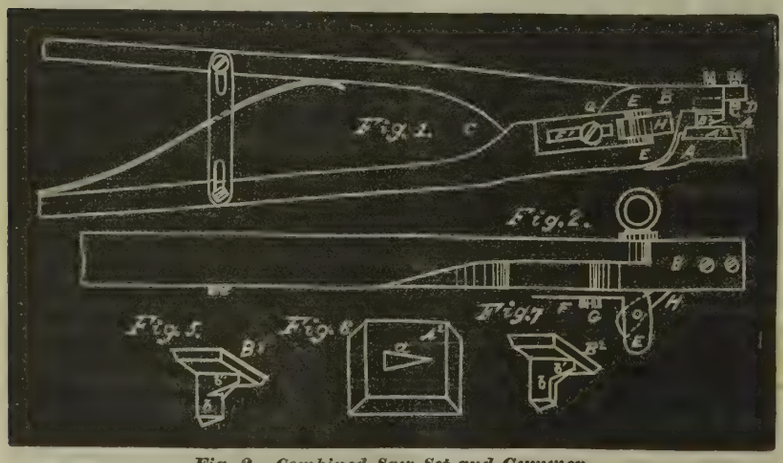


Fig. 2.—Combined Saw Set and Gummer.

either parallel or at a bevel, the adjustment being effected without disturbing the fence.

Fig. 2 illustrates a combined saw set and gummer, invented and patented by Elijah A. Parks, of South Bend, Ark. The following points are claimed as novel: 1. In a saw set and gummer, the combination, with the tongs C, provided with dovetailed grooves A′ and B′ in the jaws A and B of the female die A^2, provided with a triangular aperture or recess *a*, and the male die B^2, provided with a projection *b b′* fitting within the aperture or recess *a*, for the purpose set forth. 2. In a saw set and gummer, the combination, with the tongs C, of the dies A^2 B^2, held in the jaws thereof, the plate F, provided with lugs E, and the block H, pivoted in these lugs. 3. In a saw set and gummer, the combination, with the tongs C, of the dies A^2 B^2, held in the jaws thereof, the longitudinally slotted plate F, provided with lugs E, the block H, pivoted to these jaws, and the screw G. 4. In a saw set and gummer, the combination, with the tongs C, of the die B^2 and the plate K, provided with an aperture *k*, and a recessed guide strip N extending across it. 5. In a saw set and gummer, the combination, with the tongs C, of the die B^2, the plate K, having its outer portion raised above the inner portion, and of the guide strip N. 6. In a saw set and gummer, the combination, with the tongs C, of the die B^2, the plate K, and the screw L, passing through a slot M in the jaw A.

Fig. 3 illustrates a saw sharpening tool, invented and patented by Robert S. Munger, of Mexia, Tex. The following points are claimed as novel: 1. A rotary saw sharpening tool having a curved edge-shaped rim provided with filing surfaces on the edge and each side thereof, one or both of which sides are inclined inwardly from heel to edge towards the axis of the tool, for the purpose described. 2. A rotary self-feeding saw sharpening tool, having an edge-shaped rim of helical form provided with a file cut on the edge and sides thereof, one or both of which sides are inwardly inclined from heel to edge towards the axis of the tool.

Fig. 4 shows a saw-mill feed mechanism, invented and patented by Gustavus H. Zschech, of Indianapolis, Ind., for which the following points are claimed as novel: 1. In a circular-saw mill having the back feed shaft *m* driven by friction from a pulley on the saw shaft *b*, with provisions for moving the former toward and from the latter to make and break the connection, an intermediate pulley D, and means *e e′* for changing its position to allow for different positions of the saw shaft *b*, and adapted to transmit the motion by friction, as specified. 2. The intermediate pulley D and provisions *e e′* for adjusting up and down to compensate for change in position of the saw shaft, in combination with the pulley M on the back feed shaft *m*, means for moving the latter to make and break the frictional contact, and the provisions E′ H′ for allowing said intermediate pulley to swing and swivel.

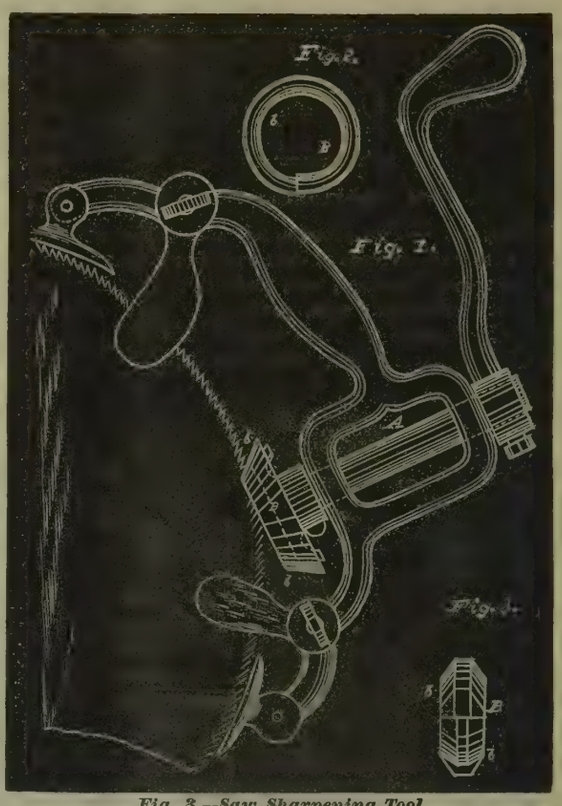


Fig. 3.—Saw Sharpening Tool.

on the other hand, becomes brown. By employing an equal quantity of sulphuric acid in the place of lead acetate, and warming a little more than in the first case, common bronze may be colored red or green with a very durable skin. And, not only this, but beautiful imitations of marble are obtained by covering bronze objects warmed to 100° Fah., with a solution of lead thickened with gum tragacanth, and afterward submitting them to the action of the above named precipitate of lead."

The foregoing item, clipped from one of our technical exchanges, has, to our certain knowledge, been traveling the rounds as a "stock" item to fill out a column for five or six years. Where it originated is past finding out, nor do we intend to try. Our only object in calling attention to it, is to pronounce it a very plausible humbug. Some years ago, having occasion to make some experiments on the surface decoration of zinc and galvanized iron, we tried the formulæ of the above receipt and found them quite useless for practical purposes. To save others from wasting time in the same way, we give the item publicity, with this explanation.

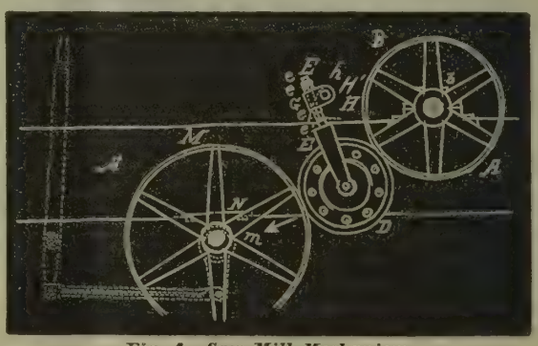


Fig. 4.—Saw Mill Mechanism.

Tinting Metallic Surfaces.

"It is found that metallic objects may be attractively colored by immersing them in a bath formed of 640 grains of lead acetate dissolved in 3,450 grains of water, and warmed to from 38° to 90° Fah. This mixture gives a precipitate of lead in black flakes, and when the object is plunged into the bath, the precipitate deposits upon it; the color acquired depends on the thickness of the skin, and uniformity of tint is insured by gradual treatment. There is thus imparted to iron a bluish aspect like steel; zinc,

A HUGE FLAGSTONE.—What is said to be the largest flagstone in America, is soon to be laid in front of the stoop of R. L. Stuart's house at Fifth avenue and Sixty-eighth street. The stone measures 26 feet 6 inches by 15 feet 6 inches, is 9 inches thick, and weighs nearly 60,000 pounds. It was cut in Sullivan county, this State, at the same quarry from which came Wm. H. Vanderbilt's great flagstone. It was drawn by eighteen horses to its destination.

The Sombart Gas Engine.

To those who intelligently observe the progress of the useful arts, it has long been known that the great desideratum for the thousands of small industries, as diversified as they are numerous, has long been a small, compact and inexpensive motive power, that should be free from the numerous objections incident upon the use of steam. This want, we feel now quite well assured, is fully met in the gas engine, which, within a comparatively few years, has been developed from the domain of the problematical, and by a succession of highly ingenious improvements has been elevated to the rank of a successful competitor with the steam engine, both from the mechanical and economical standpoint.

There are numerous indications that prove to the intelligent observer, also, that the future of the gas engine, now that it has been developed into a practically successful machine, will be a very important one. In fact, in Europe, in its several forms, it has already acquired a very extensive introduction, and its position as a successful rival of steam is no longer questioned. These statements will not be questioned by any one who is at all familiar with the extent to which gas engines are in use to-day in Germany, France, Belgium, England and other leading industrial countries of Europe. It has taken some time to familiarize Americans with these novel motors, but now that their merits have become generally known, they are rapidly growing in popularity, and deservedly.

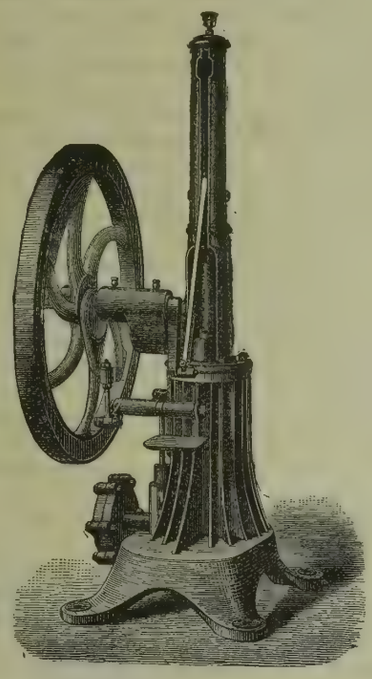
Another indication of the future importance of this form of motor, is the rapid introduction of the electric light both for public and private uses, which bids fair to become in the near future almost universal. With this will go likewise with equal force the extension of the uses of gas for industrial purposes, a field which gas companies in this country have left comparatively uncultivated, though in Europe it has enormously increased the consumption of gas, and proved a source of profit to the companies. Finally, we may point in this introduction to the curious fact which has been practically demonstrated, that as a matter of economy, measured in terms of light produced in candle-power, it is cheaper to use gas as the motive power for generating the electric light than to use the gas for the direct production of light.

Besides these general considerations, we should not omit to mention the salient advantages on the score of convenience which the gas engine possesses over the steam engine. The gas engine may be started instantly; it has no fire to build and look after, and no boiler to watch; it requires no engineer; requires no coal; makes no ashes, is free from the danger of explosion; may be started with a match; gives out its full power at once on starting; and when idle is wasting nothing. For the multitude of small industries where power is required not constantly, but at intervals, say several hours during the day, or where the introduction of steam power is objectionable, the gas engine affords an admirable substitute.

We show in the accompanying illustration a representation of the Sombart gas engine, an engine of this class which is thus far comparatively unknown on this side of the ocean, but which has been extensively introduced in European countries, and is now being manufactured here with the view of supplying the American demand for these convenient motors.

The source of power in this engine is very similar to that of the well-known Otto engine—ordinary coal gas and air being mixed in proper portions and ignited in a cylinder. These engines, as described by the makers, are exclusively designed for small powers up to 2 H. P., to be used for small shops and miscellaneous domestic industries. In design and construction, as will be evident from an inspection of this engraving, they have been simplified as far as consistent with mechanical efficiency. Their construction and operation will be understood from the following description:

In the working cylinder a piston ascends and descends, the metallic packing of which is made to fit the cylinder tightly. The piston requires no lubrication, and is coupled to the crank by means of the piston rod, slide block and connecting rod. The engine being single acting, is provided with an equilibrium piston valve which feeds and discharges the cylinder from its under side only. The cylinder is supplied with inflammable gas, such as coal gas, volatilized gasolene, etc., by means of an india rubber tube, or any other suitable pipe or valve, and with atmospheric air by a larger valve. The mixture of gas and air is sucked into the cylinder through the piston valve when the piston begins to rise until the bottom of the latter has passed the opening of the ignition valve, whereupon the igniter inflames the explosive mixture contained in the lower portion of the cylinder. The ascending stroke of the piston is completed by virtue of the expansion of the mixture of gas and air caused by the explosion. When the piston descends the burnt gases are blown out of the cylinder through the exhaust pipe. The cooling of the cylinder is not effected by water, but by the peculiar



The Sombart Gas Engine.

form of the exterior of the cylinder, which is provided with a number of radiating ribs for the purpose of increasing the surface of radiation. The piston valve placed at the side of the cylinder is equilibriated and placed in such a manner as to dispense with lubrication.

The makers call attention to the following elements of improvement embodied in the design of their engine: 1. The igniter, by which not only the heating of the engine before starting is dispensed with, but a more perfect and reliable ignition of the explosive mixture in the cylinder is secured. 2. The piston valve, which, in lieu of working in the bore of a body cast in one piece with the cylinder as before, now slides in an isolated piece embracing the gas valve and the exhaust pipe, and can be firmly connected to and easily taken off the cylinder by means of screw studs. The result of this being, that any wearing of these parts involves no displacement of the whole engine, but of this part only. 3. The air and gas valves are now provided with perforated sheet-iron disks, which prevent the burning of the india rubber rings contained therein. 4. By a peculiar arrangement of the air valves the engines run almost silently, so that they can be placed on any floor. 5. The eccentric is now removed to the end of the crank-shaft bearing, quite near the fly wheel, and is fixed to the latter, thus preventing it altering its position in relation to the fly wheel. 6. To prevent the cylinder from being heated by the igniter flame, a small chimney is placed just above it, through which the flame escapes without coming in contact with the cylinder wall. 7. The gas supply and regulating apparatus replaces most advantageously the old and impracticable spring pinch cocks for regulating the flow of gas.

These engines are very substantially constructed, and work so well that repairs are rarely necessary. The parts, however, are made on the interchangeable system, and any part required can be obtained from the makers' stock.

By introducing certain modifications, these engines have been successfully adapted for operating with gasolene gas, by which those residing remote from cities may provide themselves with a cheap and highly convenient motive power. At present five sizes are made, namely, $\frac{1}{8}$, $\frac{1}{4}$, $\frac{1}{2}$, 1 and 2 horse-power. These engines are admirably adapted for running small lathes for all descriptions of work, grinding mills, churns, washing machines, church organs, printing presses, blowers, emery grinders, spice mills, sewing machines, sausage machines, hoists, etc., in fact, for all situations where moderate powers are required; their economy, as compared with the steam engine, is most manifest when the power is not required continuously.

These engines are made by the Sombart Gas Engine Co., of 215 Center street, New York., who will furnish further details as to size, power and gas consumption, on application. The engines may be seen in operation at the office of the company.

What we Waste.

The Hon. Edward Atkinson, in his recent able address at the opening of the New England Manufacturers' and Mechanics' Institute Fair in Boston, estimated the annual producing capacity of the United States at $10,000,000,000; the consumption was placed at 90 per cent, or $9,000,000,000, which left a margin of $1,000,000,000. Of this margin, one-half was estimated to be necessary to maintain existing capital, leaving but $500,000,000 as the net yearly profit of the nation.

Commenting on this interesting theme, our neighbor the *Textile Monitor* is inclined to believe that Mr. Atkinson, while correctly stating the earnings of the nation, has placed the expenditures too high; and is of opinion that the annual increase of wealth is much in excess of the figures named above.

Taking the figures of Mr. Atkinson as approximately correct, our contemporary endeavors to show, and we think succeeds, that we are annually wasting more than we save. Taking the item of cotton, it affirms, on Mr. Atkinson's own authority, that in the item of imperfect ginning and packing, fully $60,000,000 per year is wasted; while in cotton seed, the best authorities estimate that fully $50,000,000 per year is wasted that could and should be profitably utilized. Here, therefore, in the single item of cotton, we have an annual wastage equal to 20 per cent of the total annual gain in wealth of the nation.

Of other items that swell the annual volume of waste to figures surpassing our gains, our contemporary mentions the waste of sewage and offal that are annually turned into the streams and harbors, and which, if converted into fertilizing agents, would represent, in increased fertility of the exhausted soils of many of our older settled states, an increase in the food supply sufficiently large to feed one-fourth of our population.

Again, the annual destruction of sheep by dogs in the agricultural regions, especially of the South, where these animals are a positive scourge to the sheep-raiser, can only be represented by millions of dollars. We pay at least $100,000,000 yearly to foreigners for the carriage of our products in foreign ships—a sad commentary on the decadence of American maritime greatness. Lastly, our neighbor names, as the greatest source of waste, the demoralization caused by drink, in lessening the productive forces

of the nation by the annual destruction of thousands of vigorous minds and bodies.

To these instructive and telling facts, we will add a few that do not make themselves so obvious on the surface, but which are none the less stupendous and far-reaching in their ultimate consequences because they are hidden or pass unnoticed. Of the coal that we mine, at least 60 per cent is wasted before it reaches the market, most of this enormous quantity, representing perhaps 50,000,000 tons annually, being left in the mines, or at the breakers, as waste. At $3 per ton, this item, could it be saved, would represent $150,000,000, or more than 25 per cent of the annual profit of the country. The destruction of timber is going on over the whole country at an appalling rate, and it will require but a few years before the absolute necessity of a rational utilization of this source of national wealth will be felt in a timber famine. When this heedless and improvident waste of timber is actually brought home to us, it will be found that it is far easier to destroy than to build up. Meantime, we go on recklessly squandering our bounteous national sources of wealth without regard for the future, while we should regard ourselves as their custodians, responsible to future generations for their intelligent and provident use.

Building Intelligence.

Architects, Builders and Contractors are invited to send us items of interest for this department. It is our object to notice only the more important operations in building, our space being too limited for the publication of minor matters, which, besides, possess only local import. We wish to publish only such intelligence as is of general interest.

New York City Building Items.

An apartment house is to be built on Seventeeth street, west of second avenue, for Thomas Osborne.

A new wing will soon be added to the Grand Union Hotel, fronting on Forty-first street, and costing about $65,000.

Five flat houses, to cost $100,000, are to be erected at Second avenue and One Hundred and Fifth street, by Samuel Simmons.

Four three-story houses are to be built on the south side of Fifty-eighth street, 200 feet west of Sixth avenue, at a cost of $45,000.

A large apartment house is soon to be begun by Gideon Fountain on an Eighth avenue corner, to be five stories high, and to cost $70,000.

A factory building, seven stories high, is to be erected on the Eastern Boulevard at Seventy-first street, by Edward Leissner, at a cost of $70,000.

A large apartment house, 75 by 100 feet, on the Home Club plan, is soon to be erected on the corner of Sixth avenue and One Hundred and Thirtieth street.

A fine four-story private house, in the modern Gothic style of architecture, is to be erected on the north side of Fifty-seventh street, between Sixth and Seventh avenues.

J. Brandt has plans in hand for the erection of two three-story brick houses with stores, on Baxter street near Walker, 25 by 50 feet each, by Jacob Cohen, at a cost of $15,000.

Eight four-story first-class private houses are to be erected on the plot of ground recently bought by Charles Batchelor at Seventh avenue and One Hundred and Twenty-sixth street.

Plans for eight 4-story brick flat houses, which are to be built at Fifth avenue and One Hundred and Thirty-fourth street, at a cost of $144,000, have been filed by L. Weiher, of Harlem.

George W. Da Cunha has designs for a six-story brick storage warehouse, 20 feet 6 inches by 92 feet 3 inches, to be erected by Col. Menck on Vestry street, near Greenwich, at a cost of $14,000.

Gideon Fountain proposes to erect a mammoth apartment house on the plot of ground just purchased by him on the southwest corner of Lexington avenue and Fifty-third street, 100 by 215 feet.

Plans have been furnished for five four-story apartment houses on Ninety-eighth street, west of Third avenue, having a frontage of 125 feet and a hight of 42 feet. Each building will cost about $16,000.

The architect's plans are in hand for a brick and stone church for the Episcopal Seamen's Mission. The building will run in an L-shape from Houston to West street, and its cost is put at about $30,000.

The furniture manufacturing firm of Herter Brothers has leased the property at the northwest corner of Fifth avenue and Twentieth street from Robert L. Stuart, and will erect a warehouse on the property.

D. & J. Jardine have plans under consideration for the erection of six three-story brick private dwellings, 17 feet wide on One Hundred and Eleventh street, commencing 250 feet west of Seventh avenue. E. J. King is the owner.

Plans are being made by J. G. Prayne for a spendid private residence, to be erected upon the southwest corner of Fifth avenue and One Hundred and Twenty-sixth street, on a plot 100 by 120 feet. The name of the owner is not yet disclosed.

The Mutual Life Insurance Company has selected the architects who are to prepare competative designs for its proposed building on the old post office site. The plans are to be in by December 5th, and the company will make its choice on December 20th.

B. Walther is preparing plans for the erection of four five-story and one four-story brick flat houses, 25 by 60 by 100 feet, on the northeast corner of Third avenue and One Hundred and Fourth street. The owner is Thomas Fealey, and the cost $70,000.

R. S. Clark proposes to tear down the old brick building, No. 383 Broadway, and erect an office building to be joined on to his other building on the northwest corner of Broadway and White street. It will be fitted with an elevator and other conveniences.

George W. Da Cunha has prepared plans for the erection of a six-story brick warehouse on the irregular plot of ground on the northeast corner of Hudson and Leonard streets, 32 by 90 feet. The owner, Frederick Bechstein, expects to spend $30,000 on this improvement.

R. Napier Anderson has plans under way preparatory to the alteration of the premises No. 28 Broadway, into a first-class office building. It will be five stories high, 27 feet 9 inches by 208 feet, running through to New street, and contain sixty offices, with conveniences. The cost will be $40,000.

W. P. & A. M. Parsons propose to erect a row of eleven first-class, four-story brown-stone private residences, of various sizes, on the plot of ground just purchased by them on the south side of Eighty-first street, between Fifth and Madison avenues, 100 by 225 feet, at an outlay of about $300,000.

Babcock & McAvoy have plans under way for the erection of a five-story building for St. Joseph's Institute for the Deaf and Dumb, near the site of their present building in Westchester. It will be 50 by 100 feet, with an extension 11 by 20 feet, and built of Philadelphia brick, with blue stone trimmings, at a cost of $36,000.

Thom & Wilson have plans in hand for five four-story brown-stone private dwellings, to be erected by George W. Hamilton, on the south side of Seventy-first street, commencing 80 feet west of Ninth avenue. Two of them will be 20, one 19, and two 18 feet front. They will be built in the Renaissance style, and finished with all the latest improvements.

The proprietors of the marble quarries at Tuckahoe, Westchester county, have received a contract to furnish marble for the improvements contemplated to the A. T. Stewart property at Broadway, Reade and Chambers streets. The improvements will include the erection of four new buildings and the raising of the Broadway structure two stories.

A new storage warehouse is being built at Lexington avenue and Forty-second street, by the Manhattan Storage Company. It is an odd-looking building, with heavy round corners and barred windows, which give it the appearance of a prison. Their warehouse will have a frontage of 200 feet on Lexington avenue, extending from Forty-first to Forty-second street, and will be eight stories high. In some respects it will be different from any storage warehouse in the city. It is designed to be entirely fire-proof, and, it is said, there will not be a square foot of wood used in the entire building. The only materials used will be brick, iron and cement. The offices of the company and the safes for the storage of valuables will be in the corner at Lexington avenue and Forty-second street. One of the novel features of the house will be a driveway running through the middle of it from Forty-first to Forty-second street. Here there will be four large elevators for hoisting loaded trucks to the floors above. There are to be a number of apartments on each floor, with thick walls between them; there will be only one window in each apartment. The floors throughout will be made of cement. The estimated cost of the building is $500,000. It will be completed in March or April.

Miscellaneous.

The Presbyterians are to build a college at Emporia, Kansas.

Cornell University, at Ithaca, N. Y., hopes to be able soon to build a large library building.

Rossiter & Wright have plans under way for three three-story wooden cottages at Orange, N. J., at a cost of $4,000 each.

At Hopkinton, Mass., the Congregationalists are to build a church at a cost of $30,000, to take the place of the one destroyed by fire last April.

A $70,000 four-story private house is to be built for A. D. Farmer on Pierrepont street, at the head of Monroe place, Brooklyn, N. Y.

George H. Stone is about to commence the erection of a two-story brick factory on the corner of Kent avenue and First street, Brooklyn, N. Y.

A passenger station and freight house, to cost $19,000, is to be buit at Erie, Pa. Charles E. Cole, of Cleveland, is the architect and superintendent.

Edward Cope is erecting a Queen Anne mansion on his property at Green and Tulpehocken streets, Germantown, Pa. It will cost upwards of $40,000.

A passenger station and freight house, to cost $19,000, is to be built at Fort Wayne, Ind. Chas. E. Cole, of Cleveland, is the architect and superintendent.

A house to cost $60,000, first story of stone and the roof and upper stories of tile, is to be built at Englewood, N. J., from designs of Price & Freeman, of New York.

J. R. Thomas has plans under way for a two-and-a-half-story frame cottage, in the modern Gothic style, for H. H. Chittenden, to be erected near New London, Conn.

David H. Fowler will build three three-story front and four-story rear brown-stone dwellings on the south side of Gates avenue, near Franklin avenue, Brooklyn, N. Y.

The Dubuque Paper Mill Co., at Dubuque, Iowa, have begun the erection of a brick paper mill, one and two stories, 101 by 108 feet. F. D. Hyde and J. Norton are the architects.

Rossiter & Wright have plans in hand for the erection of a small church, 40 by 60 feet, at Atlantic Highlands, N. J. The structure is for the Baptist community, and is in the Queen Anne style.

A hotel is to built by a Philadelphia company on Green Island, Lake George, N. Y., at a cost of about $50,000, to be followed by other improvements, from designs of Wilson Bros. & Co., of Philadelphia.

William H. Beers, vice-president of the New York Insurance Company, has ordered the erection of a three-story dwelling in the English villa style in Yonkers, N. Y., at Palisade and Greenwood avenues.

The erection of an extensive hotel, to be known as the Grand, at the southeast corner of Mill and Main streets, Akron, O., by Wm. Buchtel, at a cost of about $75,000, is announced. The proposed structure will have a frontage of 60 feet on Mill street and 112 feet on Main street, and will be six stories high.

Improved Forms of Steam Traps.

We present herewith a description, with illustrations, of several forms of steam traps manufactured by the Curtis Regulator Co., of 54 Beverly street, Boston, Mass., which possess some novel and practical features.

The float trap, shown in Figs. 1 and 2, is made to operate by reason of a change of pressure on the top of the piston valve, the pressure on the lower side remaining constant. Its operation will be understood from the following explanation, reference being had to Fig. 1, which shows an interior view of the trap: Assuming the valve to be closed, and pressure on the top and bottom of the piston to be equal, which would be the case under such circumstances, then there would be no outlet for any steam that should

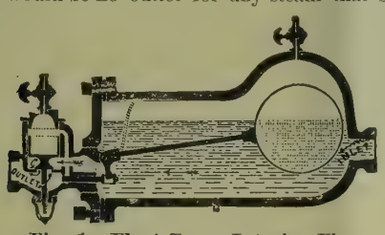


Fig. 1.—Float Trap—Interior View.

enter; the entrance of water, however, would raise the float, thus operating the secondary valve, which, on opening, would connect the top of the piston with the outlet by the side passage shown in the cut. The pressure on the top of the piston being reduced by this action, the excess of pressure beneath the piston forces it up, causing the main valve to open and permitting the free escape of the water through a passage having an area almost equal to that of the escape pipe. Before the water in the trap is low enough to uncover a passage for steam, the operation of the float will have closed the connecting passage, thus equalizing the pressure on the top and bottom of the piston and bringing the outlet valve to its seat. It will be seen from this that the outlet valve is open only when there is water in the trap sufficient to prevent the passage of steam, it being closed at other times.

In the trap here shown, designed to keep 3,500 feet of 1-inch pipe (or its equivalent) free from water, the float is only 4 inches in diameter, the case being 5 inches inside diameter, and 12 inches long. In order that a comparatively small float may satisfactorily do the work required of it, and at the same time not be influenced too much by friction, the leverage by which it opens and closes the small secondary valve is 100 to 1.

Another valuable feature in this trap is the location of the outlet valve, by which it is easy of access for cleaning and examination. The floats are all warranted to stand a pressure of 100 pounds.

Fig. 3 shows a form of trap known as the Curtis expansion trap, in which the makers have sought to obviate the objections met with in the usual forms of expansion traps—namely, the clogging of the valve with foreign matter, which prevents its proper closing and destroys its seat, all of which results from the small annular opening of valves obtained by small differences in expansion between two metals.

In this trap the outlet valve is operated by the piston A, as shown in the engraving. The space over the piston is connected with the outlet below the piston by the passage B, controlled by the small valve C. This valve C is opened against a strong spring by the contraction of the brass rod E, 4 to 5 feet in length, and situated in the iron pipe forming the outlet end of the surface to be drained. The contraction of this brass rod, less the expansion of the outside iron pipe, is about the one-1,000th of an inch for a change in temperature of 10°.

In order to make this motion effective to open the valve sufficiently to work the trap at this small variation in temperature, the motion is multiplied 10 to 1 by means of the lever shown, thus opening the valve C one-hundredth of an inch, which is ample for the purpose. The opening of this valve connects the top of the piston with the outlet, thus relieving the pressure on top of the piston, and permitting the pressure on the bottom to open the outlet valve for a free discharge of water. When the condensed water is drained from the pipes until steam comes in contact with the rod E, the heat of the steam expands the rod and permits the spring to push the valve C towards its seat. This restricts the flow through the connecting passage, thereby increasing the pressure on top of the piston, which forces the outlet valve towards its seat and diminishes the flow of water, delivering it only at the temperature at which it is set to deliver.

The rod E is adjusted for any conditions desired, by removing the cap F and turning the nut G. The spring against which the valve C is opened permits all the motion to be obtained by the rod under any fall of temperature down to freezing, while the slot in the valve, through which the operating lever passes, is elongated to permit further motion of the lever after the valve is closed, thus providing for any expansion caused by an accidental increase of temperature, without danger to valve or seat. The ability to discharge the water at any desired temperature, permits its utilization for heating. By opening the jet cock in the cap H (and this applies to both forms of trap), the pressure is removed from the top of the piston A, which then opens the outlet valve. This provides for blowing out the steam and water in the trap, together with the air and any dirt that may have accumulated. By removing the cap H, which seats metal to metal, the valve may be removed, cleaned and replaced in five minutes' time, no skill being required in the operation.

From the foregoing description, it will have been made apparent that both forms of these traps embody

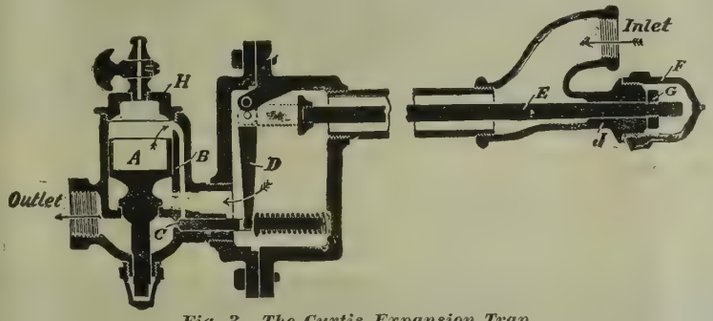


Fig. 3.—The Curtis Expansion Trap.

valuable practical features. For any details that our description may have overlooked, we must refer our readers to the manufacturers, whose address appears in the body of this article.

What Dr. Siemens Expects from the Gas Engine.

In his recent inaugural address as President of the British Association, Dr. C. W. Siemens suggested that the time might not be far distant when the gas engine would displace on board our ships "the somewhat complicated and dangerous steam boiler" now in use. The advent of such an engine and of the dynamo-machine, he declared, must mark a new era of material progress at least equal to that produced by the introduction of steam power in the early part of the century.

The great advantage of the gas engine is believed to be its saving of fuel. According to Dr. Siemens, the best steam engine yet constructed does not yield in mechanical effect more than one-7th part of the heat energy residing in the fuel consumed, whereas the factor of efficiency of the gas engine is one-quarter. If, therefore, it shall be adapted to vessels, the gas engine, being of half the weight of the present steam engine and boilers, and working with only about half the present expenditure of fuel, will admit of an addition of 30 per cent to the cargo of "an Atlantic propeller vessel—no longer to be called a steamer." That improvement accomplished, the balance of advantages in favor of such vessels would be sufficient, as he says, to restrict the use of sailing craft chiefly to the regattas of sportsmen.

As it is now, steam is rapidly driving sails from the ocean, just as iron and steel are superseding wood for ship construction. Out of the 780 vessels building, or preparing to be built, in the United Kingdom on the 30th of June last, only 130 were sailing craft, while 650 were steam ships; and of this whole number only 49 sailing vessels and 6 steam vessels were

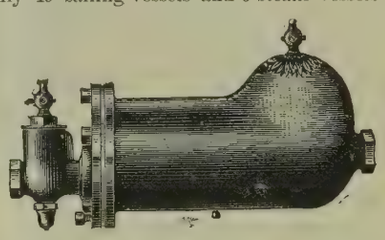


Fig. 2.—Float Trap—Exterior View.

of wood, while steel, or homogeneous iron, which is destined to become the great material for ship-building, was used for 89 steam and 11 sailing vessels.

The great advances hitherto made in steam vessels have been in the direction of saving fuel, in lighter machinery, in the substitution of the screw for side wheels, and in the use of iron and steel instead of wood for their construction. A wooden ship could not be built to perform like the *Alaska* or the *Arizona*. Whereas in the days of the old Collins line the steam was expanded only twice, and the pressure carried was only 18 pounds; the expansion now is ten or twelve times, and the pressure is 90 to 100 pounds. The old Cunarders, the *Asia*, *Africa* and *Canada*, carried a pressure of only 10 pounds.

The consequence has been the enormous increase in the size of the ocean steamers and the great advance in their speed. In April, 1838, the *Sirius* first crossed the Atlantic in seventeen days from Liverpool and fifteen days from Queenstown. She was of 700 tons and 320 horse-power. The *Servia*, built in 1881, has an extreme length of 530 feet, and a displacement of 13,000 tons. The *City of Rome*, built in the same year, is 600 feet long, and has a displacement of 13,500 tons. The *Alaska*, which is 500 feet long, and of 12,000 tons displacement, has done the distance between Queenstown and New York in 7 days, 4 hours and 32 minutes, and the return voyage in 6 days and 22 hours, a mean ocean speed of about 17 knots an hour, or more than double that of the first steam vessel which crossed the Atlantic.

Undoubtedly if the gas engine shall be able to do what Dr. Siemens acticipates, it will give ocean navigation another and a strong impulse. Its far greater lightness as compared with the steam engine and boilers, and its smaller consumption of coal to produce the same effect, will admit of a much larger cargo, and greater speed may be obtained without too much sacrifice of the cargo capacity of the vessel.

THE ELECTRIC LIGHT EMPLOYED TO CATCH FISH.—The electric light has found a novel employment in the hands of some ingenious Frenchmen, who have lately, by permission of their government, been experimenting with it as a lure for fish. The lamp was contained in an air-tight globe, and was lowered at night into the sea, with the result that thousands of fish of all sizes were attracted to its brilliant light. Boats furnished with nets gradually closed in upon the living mass, and made a great haul of fish.

The Silver & Gay Dynamometer.

The dynamometer herewith illustrated is made by Messrs. Silver & Gay, of North Chelmsford, Mass., and is designed to meet the requirements of mechanical engineers and others who have occasion to determine the actual amount of power required to operate machinery. It is upon the principle of one invented by the late Samuel Batchelder, called by him the Balance Dynamometer, which was described and illustrated in the *Journal of the Franklin Institute* for October, 1843. It is made from new patterns, designed to combine such improvements and additions as will secure accuracy, convenience and durability.

Referring to Fig. 1, the counter-shaft, to bring the driven and driving pulleys into the same vertical plane, and the dash-pot, to steady the scale-beam (both first applied by Mr. J. B. Francis), add much to convenience in placing and operating. The arrangement of the dash-pot stand and scale-beam, so that they may be used on either side, is for convenience in placing and to avoid crossing belts. The trucks, upon which the machine may be supported, make it easy to move and to adjust in position. The speed indicator (Fig. 2) may be thrown into or out of gear at pleasure, and will indicate the number of revolutions in the interval. The scale-beam and plate-weight, on the size illustrated, are figured to indicate the force exerted at a point which, if revolving around the axis of the shaft, would describe a circle three feet in circumference.

The position of the hook-weight on the beam (balanced when at the zero notch) will indicate by tenths of a pound, up to twelve pounds, the weight raised three feet to a revolution, and the plate-weights, when placed in the pan, will indicate, as figured, 5, 10, 25, 50 and 100 pounds, raised 3 feet to a revolution.

With the speed at 1,000 revolutions per minute, and resistance requiring all the weights (202 pounds) to keep the beam in a horizontal position, the result would be

$$\frac{202\times1{,}000\times3}{33{,}000}=18^{4}/_{11}\text{ H. P.}$$

When W represents weight, and R revolutions per minute.

$$W\times R\times3=\text{foot-pounds, and}$$

$$\frac{W\times R}{11{,}000}=\text{horse-power.}$$

The pulleys are three feet in circumference, so that the weights indicate also the force at their surface, or the strain on the belt. The size illustrated is capable of transmitting and weighing the power requisite to operate any machinery which can be driven by a belt 4 inches wide running 3,000 feet per minute.

Chimneys.

We think we may safely venture the assertion that at least one half of the chimneys in use to-day in connection with boilers are altogether too small to economically serve the purpose for which they are used. There seems to be a very general misunderstanding in regard to their correct proportion among those most deeply interested in their efficient performance, etc.—the owners of the chimneys themselves.

The object of a chimney is, of course, well known to be the means by which the draft necessary for the proper combustion of the fuel is produced, as well as to furnish a means of discharging the noxious products of combustion into the atmosphere at such a hight from the ground that they may not be considered a nuisance to people in the vicinity of the chimney. Regarding the second of the above purposes for which chimneys are built, we need only say that it is of secondary importance only, and that where due attention is given to the proper methods of setting boilers, and proportioning grate areas, furnaces and rate of combustion, the smoke nuisance is comparatively unknown, and is of no practical importance whatever. The main points, then, to be considered in designing chimneys, are the right proportions to insure, first, a good and sufficient draft, and, second, stability.

Without entering into any demonstration of the velocity of the flow of the heated gases through the

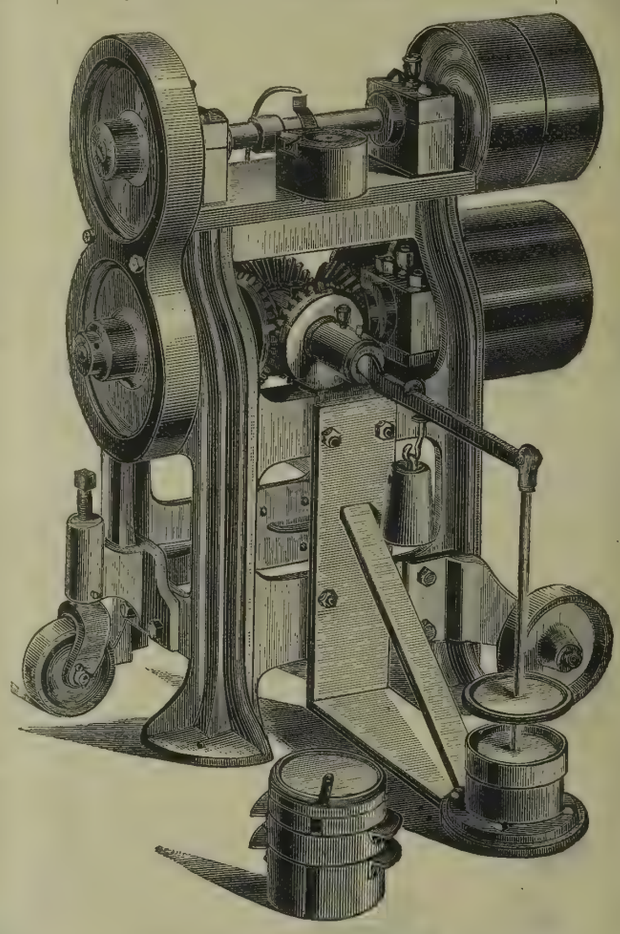


Fig. 1.

furnace and flues leading into and up the chimney, we will briefly state a few of the principles governing the dimensions of chimneys. The motive power, or force, which produces draft, is the action of gravity upon the difference in the specific gravities of the heated column of the gases of combustion inside the

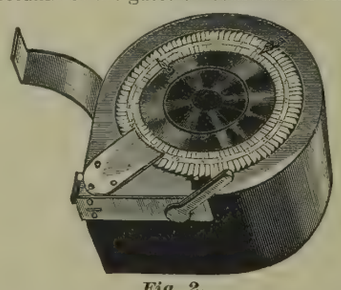


Fig. 2.

chimney, and the atmosphere at its normal temperature outside of the chimney, by which the former is forced up the flue; and the laws governing its velocity are the same as those governing the velocity of a falling body, and it can be proved that its velocity, and consequently the amount or volume of air drawn into the furnace, and which constitutes the draft, is in proportion to the square root of the hight of the chimney. It is a common error that the force of the draft is in direct proportion to the hight; so that with two chimneys, of the same area of flue, one being twice the hight of the other, that the higher one would produce a draft twice as strong as the other. The intensity of draft under these circumstances would be in the proportion of the square root of 1 to the square root of 2, or as 1 to $1^{42}/_{100}$. To double the draft power of any given chimney by adding to the hight, it would be necessary to build it to four times the original hight. Practically, there is a limit to the hight of a chimney of any given area of the flue, beyond which it is found that the additional hight increases the resistance, due to the velocity and friction, more rapidly than it increases the flow of cold air into the furnace. For chimneys not over 42 inches in diameter the maximum admissible hight is about 300 feet.

From an investigation of the same laws, we find that the velocity of the flow of cold air into the furnace is in proportion to the square root of the ratio between the density of the outside air and the difference in the densities of the outside air and the heated gases in the chimney, from which we may deduce the fact that very little increase of draft is obtained by increasing the temperature of the gases in the chimney above 550° or 600° Fah. By raising the temperature of the flue from 600° to 1,200°, we would increase the draft less than 20 per cent, while the waste of heat would be very considerable. Conversely, we may reduce the temperature of the flue about one-half when the temperature is as high as 600°, by means of an economizer, or otherwise, and the reduction of draft force would be only about 20 per cent, as before.

It is found that the principal causes which act to impair the draft of a chimney, and which vary greatly with different types of boilers and settings, are, the resistance to the passage of the air offered by the layer of fuel, bends, elbows and changes in the dimensions of the flues, roughness of the masonry of brick flues, holes in the passages which allow the entrance of cold air, and generally any variation from a straight, air-tight passage of uniform size from combustion chamber to chimney flue, and the resistance to draft is in direct proportion to the magnitude and number of such variations.

In designing a chimney, it is, therefore, always necessary to consider the type of boiler, method of setting, arrangement of boilers and flues, location of chimney, and everything which will be likely to in any way interfere with its efficient performance. Much, of course, depends upon the judgment and experience of the designer, and it would be impossible to give any general rule which would cover all cases. When only one boiler discharges into a chimney, for instance, the chimney requires a much larger area per pound of fuel burned than when several similar boilers discharge into a chimney of the same hight; and, taking all these varying circumstances into consideration, a great deal of judgment is in many cases required to determine the proper dimensions.

It is a common idea that a chimney cannot be too large—in other words, the larger the area of the flues the better the draft will be; but this is not always the case. In many cases where a chimney has been built large enough to serve for future additions to the boiler power, the draft has been much improved as additional boilers have been set at work. The cause of this is to be found in the increased steadiness of draft where several boilers are at work and are fired successively, as well also as in the better maintenance of the temperature of the flue, as the velocity of the gases necessarily increases with the increased amount required to be discharged, and they do not have time to cool off to so great an extent as when they move more slowly.

THE WORLD'S PRODUCT OF LEAD for last year is estimated by Herr Landsberg at 440,000 tons. China and Japan are not included as producers of this metal, although the probability is that their out-put of lead is very large every year.

Proportions of Riveted Joints.

[*Continued from page* 251, *November Number.*]

Resuming the subject of the proportions of riveted joints from the able series of articles from the *Locomotive*, published by the Hartford Steam Boiler Inspection and Insurance Co., we take up in conclusion some further examples of double riveted joints:

Fig. 20.—⅝-inch plate, double riveted; rivet holes, $^{13}/_{16}$ inch diameter; pitch of rivets=3¼ inches. Strength of plate at joint

$$=\frac{3.25-.8125}{3.25}=75 \text{ per cent of solid plate.}$$

Strength of rivets at joint

$$=\frac{.51849\times2}{3.25\times.375}=85 \text{ per cent of solid plate.}$$

Fig. 21.—$^{7}/_{16}$-inch plate, double riveted; rivet holes, ⅞ inch diameter; pitch of rivets=3⅜ inches. Strength of plate at joint

$$=\frac{3.375-.875}{3.375}=74 \text{ per cent of solid plate.}$$

Strength of rivets at joint

$$=\frac{60132\times2}{3.375\times4375}=81 \text{ per cent of solid plate.}$$

Fig. 22.—½-inch plate, double riveted; rivet holes, $^{15}/_{16}$ inch diameter; pitch of rivets=3½ inches. Strength of plate at joint

$$=\frac{3.50-.9375}{3.50}=73 \text{ per cent of solid plate.}$$

Strength of rivets at joint

$$=\frac{69029\times2}{3.50\times.50}=79 \text{ per cent of solid plate.}$$

The foregoing we believe to be as good and systematic proportions for riveted joints as have been published by any one. We have given the size of the rivet holes in estimating the strength, in every case. The rivets would, of course, be $^{1}/_{16}$ inch smaller. In practice the holes generally are not more than $^{1}/_{32}$ inch larger than the rivets which are driven in them; in that case, the proportionate strength of plate given above would be somewhat increased.

Plates more than ½ inch thick should never be joined with lap joints. When it is necessary to use them, a butt joint with a double fish-plate should always be used. In recommending the above proportions, it is assumed that the workmanship is always fair. In these days there is no excuse for poor and slouchy workmanship under any circumstances.

The proportions of the foregoing are as follows: Thickness of plate, ¼, $^{5}/_{16}$, ⅜, $^{7}/_{16}$ and ½ inch; diameter of rivet, ⅝, $^{11}/_{16}$, ¾, $^{13}/_{16}$ and ⅞ inch; diameter of rivet hole, $^{11}/_{16}$, ¾, $^{13}/_{16}$, ⅞ and $^{15}/_{16}$ inch; pitch, single riveting, 2, $2^{1}/_{16}$, 2⅛, $2^{13}/_{16}$ and 2¼ inches; pitch, double riveting, 3, 3⅛, 3¼, 3⅜ and 3½ inches; strength of single-riveted joint, .66, .64, .62, .60 and .58 per cent; strength of double-riveted joint, .77, .76, .75, .74 and .73 per cent.

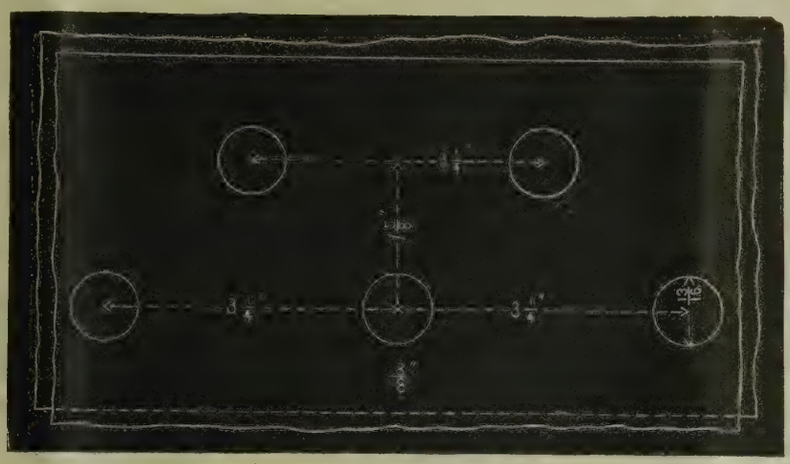


Fig. 20.

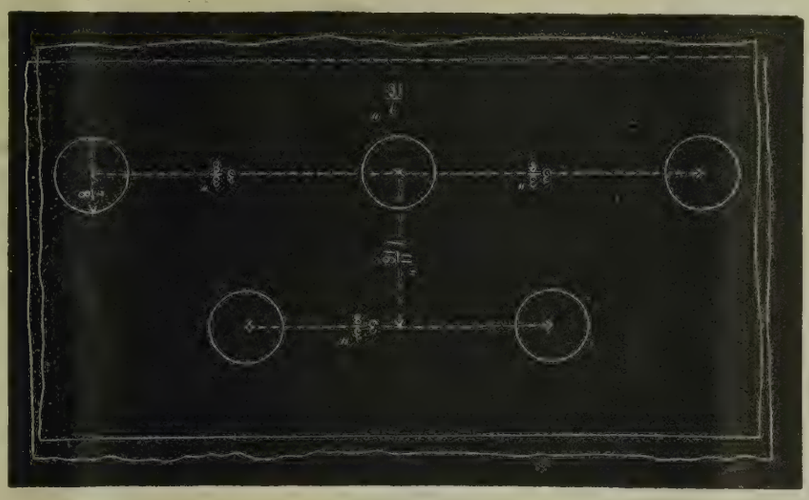


Fig. 21.

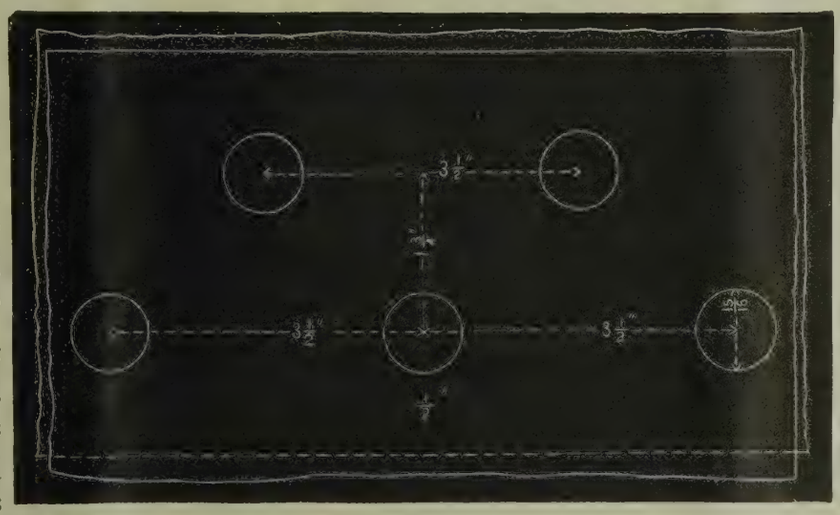


Fig. 22.

Nickel-Plating without the Battery.—The *Wiener Gewerbe Ztg.* contains the following procedure recommended for nickel-plating without the use of a battery, by Dr. R. Kaizer:

He proposes a bath of pure granulated tin, argols and water, which he heats to boiling, and adds thereupon a small quantity of highly heated oxide of nickel. A quantity of the nickel is dissolved, as is shown by the green coloration of the solution. If a copper or brass article is immersed in this solution, it is affirmed that it will almost immediately become coated with a silvery coating which consists of almost pure nickel. By adding a small quantity of a cobalt salt (carbonate or tartrate), the coating assumes a bluish tint, the depth of which can be regulated according to the quantity of cobalt added. The articles may be given a high polish by rubbing with dry sawdust or chalk.

This procedure closely resembles that of Stolba, reported in this journal some time ago. We fail to see any advantage in Kaizer's process over that of Stolba's, if, indeed, it will answer as well.

Forests and Climate.

Dr. Schomburgh, the director of the Botanical Gardens of Adelaide, South Australia, has written a recent pamphlet on the influence of trees upon climate. Contrary to the opinions now beginning to be generally accepted by scientific men, the object of the paper is to prove that the destruction of forests usually has the effect of reducing the rainfall, while, on the contrary, the planting of trees broadcast over a country is one of the best methods which can be adopted for ameliorating its climate and increasing the annual fall of rain. Ploughed land attracts moisture to a much greater degree than the unbroken soil.

In considering the effect which the removal of forests has had in altering the climate in South Australia, the only direct test that could be taken from the records issued by the government astronomer, is the experience of the neighborhood of Adelaide. If the time is divided which has elapsed since 1839, the year in which observations were commenced, into two periods, there is found for the first an average rainfall of 22.8 inches, and for the second one of 21.7 inches. It will thus be seen that, on the whole, the rainfall at Adelaide is diminishing, though very slightly, and perhaps the diminution in the amount of timber may have something to do with the change.

Dr. Schomburgh, in searching for illustrations of the effect of trees on climate, goes further a-field, and brings forward some instances in which he claims that loss of forests means loss of rainfall, and *vice versa*. He recalls how the Russians, by burning down some of the trans-Caucasian forests at the time of their struggle with the Circassians, converted the country from a fertile land into a desert, simply through the cutting off of the supply of rain. Similar instances of rain having deserted a country denuded of forests have occurred in the Mauritius, in Jamaica, the Azores, and it may also be added to a still more remarkable extent in several of the smaller West India islands. No sooner had the forests of these places been destroyed than the springs and rivulets began to cease to flow, the rainfall became irregular, and even the deposition of dew was almost entirely checked. On the other hand, it is accepted that Mehemet Ali increased the fertility of Egypt enormously by planting trees. He alone planted some 20,000,000 on the Delta; his successors followed up the work, and the rainfall rose from 6 inches to 40 inches.

Planting has also, says Dr. Schomburgh, produced remarkable effects in France and Algiers. Extensive regions have been planted with gum and other trees,

which, for the most part, grew to about 30 or 40 feet in hight, and it is noticed that the quantities of rain and dew which now fall on the adjacent land are double what they formerly were.

Improved Construction of Theaters.

In connection with our editorial remarks in last issue, on the subject of fires in theaters, we present herewith some details of the improvements in the construction of such buildings, which embody the principles which we showed to be necessary.

The cuts (Figs. 1 and 2) represent a method of construction devised by Mr. Louis Sues, of Chicago, the object of which is to do away with the danger arising from the immense volumes of smoke, that, in case of fire on the stage, pour into the body of the theater, by reason of the great draft of the ventilator, usually situated in the center of the auditorium ceiling above the main chandelier. The object of Mr. Sues' invention is to provide a counter-draft on the stage, which, in the event of a fire, will be strong enough to overcome the combined action of the open doors and the ventilator; and he proposes to accomplish this object by placing a chimney, or flue, on the top of the stage which will carry off all the smoke and cinders. Mr. Sues' smoke flue will be best understood from his patent specification, the essential features of which we quote, in connection with the diagrams, of which Fig. 1 is a vertical section, and Fig. 2 a detail in perspective:

"Theaters frequently take fire, and in almost all cases the fire originates in that portion of the building devoted to the stage and scenery. There is usually a draft from the stage to the auditorium, especially when the doors are opened, and the flames and smoke pass rapidly from the stage to the audience-room. The object of my inventions is to construct theaters so that this difficulty will be obviated to a great extent, and it consists in a large outlet in the roof over the stage for the passage of smoke in case of fire, so that a current of air will be induced from the auditorium to the stage instead of from the stage to the auditorium, and combining with such outlet a ceiling over the stage portion of the building which will for a considerable time resist the action of fire, thus giving the audience time to escape.

"In the drawings, A (Fig. 1) indicates the auditorium; B, that portion of the building devoted to the stage; C, the stage; D, the opening between the stage and the auditorium; E is the ceiling over the stage. This ceiling I make practically fire-proof, either by making it wholly of metal or by the use of metal joists with wire or wire-cloth for lathing, and usual plastering, or in other suitable manner. F is a large passage, to be made of fire-proof material. It passes through the roof G. Its lower end is properly secured in the ceiling, and is open, except when closed by the valve *a*; *b* is a chain by means of which the valve *a* can be opened; and *c* is a weight which holds the valve in position when closed.

"The operation is as follows: If a fire breaks out upon the stage, the valve *a* is to be immediately opened. The ascending heat and smoke will rise to the ceiling and escape through F, thereby producing a current from the auditorium to the stage, instead of the reverse, thus keeping the smoke and flames from the audience-room while the audience is escaping. In cases where a fire-proof drop-curtain is used, suitable openings may be somewhere provided to admit air to the stage. In theaters of the usual size, the passage F should be about six feet in diameter. It may be carried some distance above the roof, which will increase the draft. Two or more of these passages F may be used. The opening at the top of the passage F may be protected from storms by caps."

The only serious objection to this device lies in the fact that it is not automatic in operation; in other words, its efficiency as a safeguard depends on the coolness and reliability of the attendant having charge of it. In principle it is entirely correct.

Hofman, another inventor, appreciating the importance of having every detail of safety appliance to work automatically, has embodied several excellent features in a system which goes by his name. We append a brief outline of Hofman's system, from Mr. Hexamer's description:

"The ingenious device of Hofman combines an automatic wire drop-curtain, an automatic smoke-flue and an automatic fire-alarm. This device will act without the aid of a single hand, being entirely automatic. It consists of a safety-rope, which runs

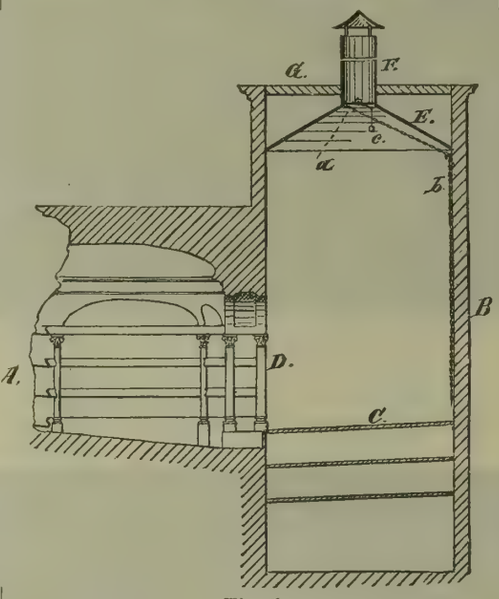


Fig. 1.

on pulleys over the principal and most dangerous parts of the stage. This rope is prepared so as to be the most combustible substance on the stage. In case of fire, it will therefore ignite and burn off almost instantly. When this moment arrives, a heavy weight, held by the safety-rope, falls. This weight being connected with the machinery of the curtain by a lever, the lever is raised, the machinery set in motion, and the curtain lowered—not, however, with a sudden fall which might damage it, but steadily. The falling of the heavy weight at the same time opens the valve of the large smoke-flue contained in the roof of the stage, whereby the smoke and heat of the fire is kept on the stage and taken out of the flue, thus giving the audience time to leave the theater quietly and orderly, without being threatened by smoke or heat. The same moment the above takes place, the fall of the weight sets a fire-alarm in motion and the fire department is notified."

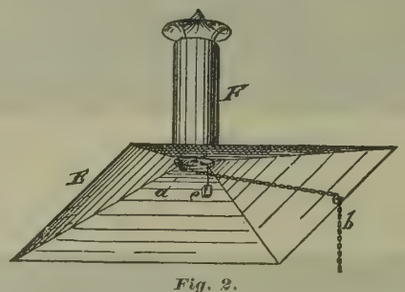


Fig. 2.

The foregoing devices, it will be observed, combine a number of excellent features that would, if generally introduced, add materially to the safety of audiences in theaters in case of fire. The safe construction of such buildings is a subject that, in view of their present perilous condition, should receive the earnest attention of the authorities, with the view to enforcing such modifications of interior construction and arrangement as may be deemed necessary or desirable to insure the safety of audiences.

We have pointed out in our references to the subject a number of changes and precautions that we believe would materially contribute to this end. They have the endorsement of expert insurance authorities, and are worthy of careful attention. It is probable that other and better plans and devices could be found, should the subject be taken up seriously by our architects. One thing is certain, that the present method of constructing theaters, as has been demonstrated by the repeated occurrence of frightful loss of life where fires have taken place, is disgraceful to our civilization, and the authorities rest under a grave accountability for permitting such constant imperilment of life, without proper effort to enforce measures of safety.

Weight of Men and Women.

Permission was given the department of Scientific and Educational Appliances at the Cincinnati Industrial Exposition, to employ a clerk to record the weights of visitors who wished to avail themselves of the privilege. The sheets containing the record have now been added up, and the committee report as follows:

The object sought was a determination of the average weight of men and women, a fact often required by civil and mechanical engineers. Haswell states that the average weight of 20,000 men and women, weighed at Boston in 1864, was—men, 141½ pounds; women, 124½. We have always thought these weights too low for Western people.

The number weighed at the Tenth Cincinnati Industrial Exposition was			22,155
The total weight			3,072,306 lbs.
Men weighed	7,467,	weight	1,150,108 "
Women weighed	14,688,	"	1,922,198 "
Average weight of men			154.02 "
Average weight of women			130.87 "

For men this is 12.52 pounds higher than the Boston average, and for women 6.37 pounds higher. The average weight of people from the country, independently of the general average, was also determined with reasonable certainty. This was rendered possible by the excursions that were arriving at various times from Ohio and the adjoining states, parts of which were weighed.

FOR OHIO.

Average weight of 141 men	157.38 lbs.
Average weight of 179 women	133.26 "

FOR SOUTHERN INDIANA AND ILLINOIS.

Average weight of 124 men	158.52 lbs.
Average weight of 193 women	133.55 "

FOR KENTUCKY.

Average weight of 114 men	158.43 "
Average weight of 188 women	133.76 "

The mean of these averages is so much above the general average as to attract attention. For men it is 4.09 pounds higher, and for women 2.65 pounds. The very high, and approximate, average of those from Southern Indiana and Illinois, and from Kentucky, recalls the Kentucky origin of the former.

Curious Fact Concerning Boiling Water.

At a recent Association meeting, Mr. A. J. Haddock, A.I.C., related the following: A kettle filled with boiling water was hung in the hottest room of some Turkish baths, with the lid on. The temperature of the surrounding air was 262° Fah. After about an hour the temperature of the water was taken, and indicated, as was expected, 212°. The kettle was then rehung with the lid off. The temperature of the room was now 252°. In twenty minutes the temperature of the water had fallen to 185°; in thirty minutes, to 178°; in forty-five minutes, to 170°, and was evidently still falling. The manager stated that it generally fell finally to about 140°, when a point of equilibrium seemed to be established, and the water neither got hotter nor cooler. Mr. Haddock supposes this loss of heat was due to rapid vaporization and conversion of the sensible heat of the water into the latent heat of steam, and as dry air is a very bad conductor of heat (one of the worst known), the heat re-

quired to convert a portion of the water into steam had to be abstracted from the remainder of the water, thus lowering its temperature. In substantiation of this explanation, we know as a fact that if water is placed in a vessel over a large bulk of strong sulphuric acid, in the receiver of an air pump, and the air is exhausted, the rapid evaporation of one portion of the water will actually cause the rest to freeze.

Time Telegraphs.

The all-absorbing topic of the electrical world is at present the grand scheme of electric lighting. The enterprise of capital and the energies of genius are uniting their power to solve this problem of the day. Its shadow, just now, obscures all other electrical inventions, though their merits are by no means inferior nor their usefulness less. It is the purpose of this article to call attention to an invention of this character—a new device for time telegraphs.

This is an arrangement of electro-magnetic clocks that receive the time telegraphed from another standard weight or spring clock at certain intervals, through the medium of an electric current. The construction of time telegraphs has engaged the minds of some of the most prominent philosophers and mechanicians for almost fifty years. The priority of the invention is shared between men of such preëminence as Steinheil, Wheatstone and Baine. A great many have followed them in devoting their time and genius to the perfection of this invention.

The principle of the clock, as invented by its three great originators, is fundamentally the same, and of a rather crude character. The device consists mainly of an electro-magnet and a piece of soft iron, called the armature, or keeper. The latter is movable in front of the poles of the electro-magnet. The electro-magnet is connected with a galvanic battery, the circuit of which is made and broken by the telegraphing standard clock, in such intervals as may be desired for the proper movement of the clock hands of the time telegraph. The action of the instrument is as follows: Whenever the standard clock closes the battery, the armature is attracted, and moves towards the poles of the magnet, at the same time transmitting this movement to the machinery that moves the hands of the clock dial belonging to the time telegraph. Such instruments will do their work tolerably well if the clock hands are moved once or twice in a minute; but if moved every second or two, then their faults become apparent in a very decided manner. The clock-work is necessarily delicate, and the comparatively violent blows of the armature against the escape wheel, and the sudden check the armature is subjected to in its rapid progress towards the poles of the magnet, soon impair the good condition of such instruments and make them unreliable. To this is to be added the clattering noise these instruments produce in their action, which is so great an annoyance as to make their introduction into dwelling houses intolerable.

Strange as it may seem, notwithstanding the unabated attention electric clocks have received from some of the most ingenious inventors, they retained their crude character for almost half a century, and not until recently was an entirely new system produced, which obviates the objections to the old system noted above, and seems to be peculiarly adapted for time telegraphs and to open for them a successful future.

Louis H. Spellier, of Philadelphia, has invented an electro-magnetic escapement which avoids entirely the above mentioned faults, and of which Figs. 1 and 2 give a representation in its two principal positions. Referring to the figures, G is the electro-magnet, and B is an iron wheel that has on its circumference the projections H. These projections are armatures. Fastened to the same axle with this iron wheel is the escape wheel A, with the peculiarly shaped cog shown in the engraving; D is a lever, with an adjustable weight at F, and presses by means of the pulley E on its circumference, and rests at the bottom of the cog when the electro-magnet is not charged with magnetism. When in that position, as shown by Fig. 1, two of the armatures are very near to the poles of the electro-magnet. At the moment when the electric current passes through the coil C, and the pole G becomes magnetized, the two armatures will be attracted and take their position right over the poles of the electro-magnet, as shown by Fig. 2. The escape wheel A, fastened to the same axle with B, has moved with it and lifted up the lever D, and has in its move-

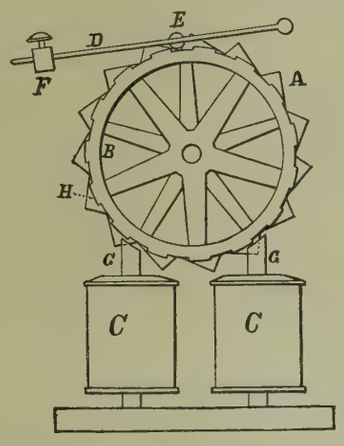


Fig. 1.

ment gone so far as to allow the pulley E to glide over the point of the cog and keep its position (see Fig. 2) until the electric circuit is broken again; then the poles G become demagnetized, the armatures are no longer attracted, and the wheels A and B move under the pressure of the pulley until it has reached the bottom of the cog. By this movement the next succeeding two armatures have taken their position (see Fig. 1), again ready to be attracted at the next closing of the electric current. In this manner is produced, by alternately opening and closing the circuit, a step-like movement of A and B.

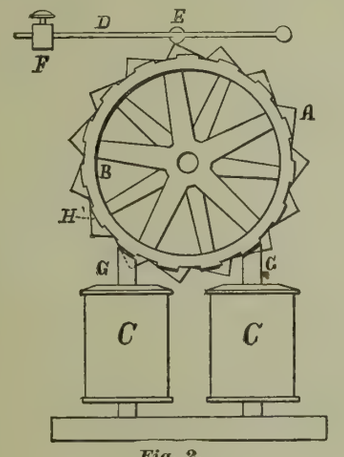


Fig. 2.

It is evident that with this arrangement the escape wheel is not submitted to any violent blows, nor the escape wheel and armature to the sudden and destructive checks of the old system. No precaution is here necessary to prevent the escape wheel from moving more than one cog at a time, since the attracting magnet, as well as the pressing lever, always brings the escape wheel just to its proper position. One of the most remarkable features of this escapement, is that it converts the very source of mischief of the old system into a useful factor. The power wasted by the old time telegraphs in suddenly stopping the armature, just when closely approaching the poles of the magnet, is stored up in the pressing lever D, to be utilized to move again the clock-work as soon as the electric circuit is broken; so that if the time telegraph indicates seconds, the use of the electric battery is needed but once for two consecutive movements of the second-hand. In other words, in two successive movements of the second-hand, one is produced directly by magnetic force, the other by the force of gravity acting through the weighted lever. In this manner the weighted lever is a recipient for the force that not only was wasted in the old system, but also proved to be so destructive to its mechanism. Thereby, as a matter of course, the battery is needed less frequently, and reduces the expense to maintain it nearly one-half—an item of considerable importance where a great number of clocks are in use.

Several of Mr. Spellier's time telegraphs have been in operation at the library of the Franklin Institute, Philadelphia, for about six months, where they have demonstrated their complete reliability, and have attracted attention for their remarkably quiet action.

Mr. Spellier has also extended the application of his invention to public clocks. At a recent meeting of that Institute, he had a time telegraph in operation for this purpose, and the work this instrument does, compared to its size, is quite suprising. The diameter of the iron core of the electro-magnet is but five-16ths of an inch, and that of the armature wheel B only 3¼ inches, and yet it developed sufficient power with two Callaud cells to drive the clock-work of four dials of 27 inches in diameter. This certainly seems to be a very favorable result, and may at no very distant time prove of great value, as it shows that a good regulator, removed from the influences of the changes of the weather, can control the dial works of a large public clock through the electric current furnished by a comparatively small battery.

The Committee on Science and the Arts of the Franklin Institute recognized the fact that Spellier's invention had made time telegraphy more practicable when it awarded to the inventor the Elliott Cresson gold medal—a distinction so rarely bestowed, that it was but the eighth medal granted since the foundation of the award—a period of thirty-two years.

Submarine Work.

Thanks to the enterprise of an English firm, the submarine diver of the future is likely to have all the advantages which Jules Verne gave to the divers in his wonderful work, "Twenty Thousand Leagues Under the Sea." Our readers will remember that the divers are represented by the author as putting on their armor in the usual fashion, and then attaching oxygen reservoirs at the back, going into the water free and independent of air pumps and heavy-dragging air pipes. The new system calls for the manufacture of oxygen and its compression into tanks, which are strapped upon the armor. The carbonic acid of the breath is removed by means of caustic potash, and a fresh supply of oxygen takes the place of that used up by breathing. The diver is, of course, entirely independent of the surface, and can walk about as much at his ease as it is possible beneath the surface of the water, weighted by the usual amount of lead necessary to keep him submerged. The system is one of the most interesting things in its line that has been brought before the public for many years, and submarine work will be greatly benefited by it. No doubt some time will be necessary to understand practically all the details of its working, as the system is not presented as being in a sufficiently practicable state to be in every-day use away from skillful attendance.

Sugar-Beet Cultivation.—Mr. Ware, in his pioneer journal, the *Sugar Beet*, says, respecting the cost and difficulty involved in raising the beets: "The truth is, sugar-beet cultivation is, without doubt, the most paying of all crops, providing that scientific rules are strictly adhered to; but is a curse to all growers who launch out in the paths of originality with the view of demonstrating their theories, that none but themselves endorse, and the absurdity of which they discover when too late.

Scientific

Straw Lumber.—Recent newspaper statements convey the information that a company has been formed for the purpose of engaging in the manufacture of straw lumber, after the process devised by Mr. S. H. Hamilton, of Lawrence, Kan.

The first publicity given to Mr. Hamilton's process was at the meeting of the American Association for the Advancement of Science, last year; and in our "Association Notes" for that year, we gave a brief statement of the invention, which at the time attracted much attention from its novelty and the meritorious features claimed for it.

The company above referred to has lately erected a large mill in Lawrence, Kan., and is now engaged in turning out straw lumber in limited quantities. The machinery used has been constructed specially for the purpose, but in some respects it resembles that used in paper manufacture. All kinds of straw are used, the raw material being first made up into pulp in the usual manner, and then rolled into thin sheets, twenty-four of which would make an inch in thickness. While wet and hot, and in a condition to readily absorb liquids, these sheets are passed through a vat containing certain chemical impregnating substances heated to 280° Fah., by which treatment they become thoroughly impregnated with the materials of the bath. The sheets are then passed through a series of polished iron rollers; cement is applied to them by a special arrangement provided for the purpose, and the ultimate result is the production of a hard, firm and completely fire-proof slab, which is properly described by the name "straw lumber" which is given to it. After manufacture, the lumber is allowed to thoroughly dry, an operation which takes from a week to a month, according to thickness. Upon the thoroughness of the drying depends its subsequent freedom from warping. The drying is done in a dry-storehouse, kiln-drying being found not to answer.

On the authority of the *Northwestern Lumberman*, we glean that thus far the straw lumber has been made principally into flooring, ceilings, blackboard strips and friction wheels. The present machinery can only turn out boards of different thicknesses, 13 feet long and 3 feet wide, which can be sawed into any shape, the same as common lumber. They cannot be split into thinner slabs, but must have the right thickness for the use intended. With the extension of the use of the new material, additional machinery will be provided for turning out material of any length, width and thickness that may be desired. While the capabilities of straw lumber, in the estimation of our contemporary, seem limitless, the manufacturers make no extravagant claims for it, only seeking to have it applied to the more simple and practical wants until experience in its manufacture and uses shall enable them to intelligently extend its sphere.

When finished, it looks like what it is—a slab made from straw. The surface has an appearance of unevenness, which is deceptive, for while it looks rough it is found to be smooth. The fibrous character of the materials of which it is made give it a streaky appearance. It is very hard, compact and firm, saws perfectly smooth, and a nail can be driven through it very cleanly, and without cracking, splitting or tearing, as wood often does. The makers claim that it can be readily polished, finished and decorated upon the surface in any desired manner, and that it can be worked, sawed, planed, etc., the same as wood. The new material is affirmed to be as strong, or stronger, than wood, to surpass it in endurance, and to possess water and fire proof qualities to an extraordinary degree. For floors and ceilings it is said to have shown itself to possess all the meritorious qualities claimed for it. Friction wheels made of it are affirmed to have outlasted three sole leather wheels. It is much heavier than wood slabs of equal dimensions, and this may be an objection for certain uses. It is proposed to use it extensively for veneer. It is reported that the new material is about to be used in the construction of a large six-story building, covering an entire block, which is about to be erected by Mr. John V. Farrell, an extensive dry-goods operator in Chicago.

Concerning Disinfectants.—An earnest discussion is at present going on in certain scientific circles respecting the virtue of disinfectants. Dr. Koch, whose researches on the infectiousness of consumption have made his name very well known, lately expressed the opinion that the only substances worthy of the name of disinfectants, were chlorine, bromine, iodine, mercuric chloride, and perhaps potassium permanganate and osmic acid. He found that spores of the bacillus of splenic fever kept for many days in 5 per cent of zinc chloride solution, developed when placed in suitable nutritive liquids, even when added to serum containing ½ per cent of zinc chloride solution. He wonders how this salt could ever have been regarded as a disinfectant.

Koch's views on this subject have lately been subjected to criticism by Boillat, who calls attention to the fact, that for a substance to be an antiseptic it is not necessary that it should actually *destroy* germs. In the antiseptic treatment of wounds, it would be impossible to employ such violently acting substances as those mentioned by Koch. All that is necessary is the presence of substances capable in some way of restraining the development of germs, which, however, may properly be called antiseptics. This, it will be noticed, is a very important distinction. Many antiseptics have the power of coagulating proteids. Boillat prepared such coagula from pure serum and egg albumen by precipitating with phenol, zinc chloride, copper sulphate and mercuric chloride. These albuminates, after being well washed to remove any excess of the precipitant, were mixed with a little water and exposed to the air. Pure serum and Koch's gelatine served to control the experiments. In the serum, gelatine and phenol albuminate, bacteria appeared in 1, 1 and 2 days respectively, and marked putrefaction in 2, 4 and 6 days respectively; while in the metal albuminates bacteria did not appear until from 31 to 45 days, and marked putrefaction in from 46 to 60 days. The surprisingly rapid putrefaction of the phenol-albuminate was explained when it was found on examination to contain no phenol. Splenic fever spores were found to develop in gelatine in 1 day, and not at all in metal-albuminates. According to Boillat, Koch did not add enough zinc chloride to his serum to convert all the proteids into the harmless but innutritious zinc-albuminate, and the spores availed themselves of the excess. Applied to the surface of a wound, zinc chloride forms a superficial coating of the neutral zinc-albuminate, which affords no means for the bacteria to develop, and protects the underlying parts.

Lightning Conductors.—From the report of the lightning-rod conference held in England, some useful hints may be gleaned. The rod at its summit should be simply beveled, so that the full conducting power of the rod may be ready to receive a disruptive discharge, while at about a foot below the extreme top there should be firmly attached by screws and solder a copper ring carrying three or four copper needles 6 inches long, and tapering from ¼ inch to as fine a point as can be made—the points to be platinized, gilded or nickel-plated. These points are to induce the silent discharge, and thus, as it were, to prevent the difference between the electric potential of the cloud and the earth reaching such an amount as to cause the passage of a spark. Vanes, finials and all pieces of metal work on the upper portions of edifices should be in metallic contact with the conductor. As to the relative advantages and disadvantages of iron and copper as material for the rods, the conference decided that in all ordinary cases copper is the cheapest and best material. The minimum dimensions fixed are: Copper—rope, ½ inch diameter; round rod, ⅜ inch; tape, ¾×⅛ inch. Iron—round rod, 9/10 inch. The weight of the latter will be 35 ounces to the foot, whereas none of the copper conductors will exceed 7 ounces.

Especial stress is laid on the great importance of perfect joints, for it is essential that there should be no resistance whatever to the passage of the electricity. For this reason copper tape, in which the joints can be easily made by riveting and embedding the ends in a mass of solder, finds most favor with the delegates. Of earth plates, the report recommends that they should always be of the same metal as the rod, should have a surface of not less than 81 feet square (that is, 9 feet on each side) and should be placed either in a well or a hole so deep that the earth will never be dry. The plate need not be notched at the edges, but should be covered with coke. Where it is impossible to find a perpetually moist earth, 300 or 400 weight of iron should be buried at the foot of the conductor, and the hole filled up with coke when the earth plate has been lowered in. To secure the moist state of the earth, rain-water pipes should be led so as to discharge over the hole.

Massage.—"Massage," from the Greek *masso* (I knead, or handle), is a term now generally accepted to signify a group of procedures which are usually done with the hands, such as friction, kneading, manipulating, rolling and percussing of the external tissues of the body, either with some curative, palliative or hygienic object in view. Its application should in many instances be combined with passive, resistive or assistive movements; and these are often spoken of as the so called Swedish movement-cure. There is, however, an increasing tendency on the part of scientific men to have the word "massage" embrace all these varied forms of manual therapeutics, for the reason that the word "cure," attached to any form of treatment whatsoever, cannot always be applicable, inasmuch as there are many maladies that preclude the possibility of recovery and yet admit of amelioration. Hence the word "cure" may lead people to expect too much; and, on the other hand, the use of the word "rubbing" in place of "massage" tends to undervalue the application and benefit of the latter, for it is but natural to suppose that all kinds of rubbing are alike, differing only in the amount of force used.

According to the requirements of individual cases, massage may be of primary importance or of secondary importance, of no importance at all, or even injurious. Concerning the extent of its usefulness, it may with safety be said that, at tolerably definite stages in one or more classes of affections in every special and general department of medicine, evidence can be found that it has proved either directly or indirectly beneficial, or led to recovery, sometimes when other means had been but slowly operative, or apparently had failed altogether. In view of these facts, it need hardly be said that those who would properly understand and apply massage should be familiar with its past and present literature; they should also be familiar not only with the natural history of the maladies in which massage may be applied when left to themselves, but also with the course of these affections when treated by the usual approved methods, so that improvements or relapses may be referred to their proper causes. Moreover, they should know something about the methods of others who have any claim to respectability in their manner of applying massage, so as to compare them with their own. And yet all of these qualifications may fail if the operator has not in addition abundance of time, patience, strength and skill, acquired by long and intelligent experience.

Ancient Human Footprints.—At the last meeting of the California Academy of Sciences, Dr. H. W. Harkness read an unusually interesting paper on the footprints of pliocene man recently found in the sandstone of the Carson (Nevada) prison quarry. The site of the Carson prison is 2,670 feet above the level of Carson desert. It is on a hill 60 feet high, formed of sandstone overlying shale, and had its origin in detritus brought by wind and water from the Sierras. About three-quarters of an acre of sandstone had been quarried to a depth varying from 15 to 32 feet, showing the hill to be composed of sandstone, alternating with layers of clay or shale. The floor left when the ledge is worked, is now bounded on the east by cliffs 7 to 15 feet high and 246 feet long. On the south the cliffs are 12 to 30 feet high and 268 feet long, while on the western side it rises from 30 to 32 feet, and extends 200 feet.

The floor of the quarry bears evidence of having been tilted at a period subsequent to the deposition of its strata. It also gives indications of having been the shore of an ancient lake. Here, under the sandstone, in the shale floor, are imprinted the footsteps of a variety of animals and birds, and many tracks of the sandled foot of man, showing rights and lefts, alongside of those of the mammoth, in a pliocene formation. The tracks were originally made in mud, so soft that a ridge was pressed up and formed around each footprint to a hight of 5 inches in some cases. These footprints were perhaps filled with water, and sand undoubtedly blew in and filled them over. Thus a miniature sand dune was formed, to protect the tracks, until all became imbedded in deep layers of sand drifting from a northwest direction, indicating the prevalence of southeast winds of those prehistoric times.

These tracks were discussed by Dr. Harkness at length, and each variety of foot print was fully described as to size, dimensions, relative position and form. Many hundred footprints were examined, varying in size, form and length of step, the stride being generally 2 feet 3 inches. As these footprints all track into the ledge, more will soon be discovered, and will be duly observed. As the ledge is worked further into, the footprints are better defined and less distended, the ground being more solid nearer the shore of the ancient lake.

Efflorescence on Brick Walls.—The Philadelphia *Times* mentions that the white efflorescence on brickwork, known to the ignorant as "saltpeter," has been particularly common in that city during the present season; several old buildings, which had long been free from it, showing as much incrustation as those of very recent construction. A reporter seems to have been enterprising enough to question Dr. Joseph Leidy, President of the Academy of Natural Sciences, upon the subject, and repeats with remarkable correctness what is certainly the true explanation of the phenomenon. According to Dr. Leidy, the efflorescence is composed of sulphate of magnesia, which is in most cases easily shown by analysis, and is produced, he thinks, by the action of the sulphurous acid, always contained in the air of cities, upon the magnesia salts in the mortar with which the bricks are laid. There is, we believe, some doubt whether the sulphurous and sulphuric acid of the atmosphere alone is sufficient to produce the effect. It is always observed that a wall, the top of which is exposed to the rain, or which receives water into its interior in any other way, soon shows a copious efflorescence, as if the magnesia salt was dissolved in the heart of the wall and brought to the surface by the evaporation of the water, so that some imagine that the coal used in burning bricks about Philadelphia and other sea-coast towns may leave a sulphurous deposit within their pores, which acts on the lime, or rather on the cement, with which they are built.

In the above, Dr. Leidy expresses the correct explanation of this annoyance, which we gave some time since in the Notes and Queries department of this journal. It is unquestionably due to the action of sulphuric acid on the magnesian mortar commonly used in Philadelphia. The action of sulphuric acid from coal-burned bricks is quite subordinate to the other.

Sunbeams.—The greatest of physical paradoxes is the sunbeam. It is the most potent and versatile force we have, and yet it behaves itself like the gentlest and most accommodating. Nothing can fall more softly and more silently upon the earth than the rays of our great luminary—not even the feathery flakes of snow, which thread their way through the atmosphere as if they were too filmy to yield to the demands of gravity like grosser things. The most delicate slip of gold leaf, exposed as a target to the sun's shafts, is not stirred to the extent of a hair, though an infant's faintest breath would set it into tremulous motion. The tenderest of human organs—the apple of the eye—though pierced and buffeted each day by thousands of sunbeams, suffers no pain during the process, but rejoices in their sweetness, and blesses the useful light. Yet a few of those rays, insinuating themselves into a mass of iron, like the Britannia tubular bridge, will compel the closely-knit particles to separate, and will move the whole enormous fabric with as much ease as a giant would stir a straw. The play of those beams upon our sheets of water lifts up layer after layer into the atmosphere, and hoists whole rivers from their beds, only to drop them again in snows upon the hills, or in fattening showers upon the plains. Let but the air drink in a little more sunshine at one place than another, and out of it springs the tempest or the hurricane, which desolates a whole region in its lunatic wrath. The marvel is, that a power which is capable of assuming such a diversity of forms, and of producing such stupendous results, should come to us in so gentle, so peaceful and so unpretentious a guise.

Scientific Suggestions.—Prof. Lockyer is of the opinion that there are many facts suggested by the spectra of solar and stellar physics which seem to show that the elements themselves, or, at all events, some of them, are compound bodies. Thus, it would appear that the hotter a star the more simple is its spectrum; for the brightest, and therefore probably the hottest stars, such as Sirius, furnish spectra showing only very thick hydrogen lines, and a very few thin metallic lines, characteristic of elements of low atomic weight. On the other hand, the cooler stars, such as our sun, are shown by their spectra to contain a much larger number of metallic elements than stars such as Sirius, but no non-metallic elements; and again the coolest stars furnish spectra characteristic of compounds of metallic with non-metallic elements. These facts appear to meet with a simple explanation, if it be supposed that, as the temperature increases, the compounds are first broken up into their constituent elements, and that those elements then undergo decomposition into elements of lower atomic weight.

Hard Bronze of the Ancients.—Ludwig has made a number of analyses of ancient bronze implements, of great hardness, with the following results:

	Copper.	Tin.	Nickel.	Iron.	Phosphorus.
(1.)	87.25	13.08	0.38	trace.	0.250
(2.)	83.65	15.99	0.63	"	0.540
(3.)	85.05	14.38	trace.	"	0.106
(4.)	88.06	11.76	"	"	0.027

Specimen No. 1 was a fragment of an ax from Maiersdorf. The metal was tenacious, and bright yellow; hardness equal to that of apatite (5). No. 2, an ax from Linburg; reddish, golden-yellow; tenacious, and hardly scratched by feldspar (6). No. 3, fragment of a sword from Steier; the metal was reddish-yellow, solid and tenacious, and not easily scratched by quartz (7). No. 4, a chisel from Peschiera; deep yellow, and containing a trace of cobalt; hardness, 5.

Neither zinc nor lead was found in any of the specimens, though the latter metal is invariably present in ancient British implements.

Electric Navigation.—Prof. S. P. Thompson lately gave a description of the trial trip of the "Electricity," a launch propelled by a screw actuated by an electro-motor, the current for which was supplied by storage batteries of the Sellon-Volckmar type. The launch is 26 feet long, about 5 feet wide, and draws about 2 feet of water, the propeller being about 22 inches in diameter. She carries 45 storage batteries, each about 10 inches cube, said to be capable of supplying 4 horse-power for 6 hours. The accumulators have an electro-motive force of 96 volts, and during the run the current through each machine was steadily maintained at 24 amperes. Prof. Thompson reports the speed of the vessel to have been about 8 knots an hour against the tide, while the return journey from London Bridge to Millwall (distance not stated) was made in 24 minutes.

Large Hailstones.—At the late meeting of the British Association, Prof. Schwedoff said some startling things about hailstones. He made mention of one hailstone 26 inches in diameter, and of another as large as an elephant, which took three days to melt. He advanced novel and startling views on the formation of hailstones. He contended that hail, exhibiting a regular crystalline form, and not infrequently falling from all points of the atmosphere, is not of atmospheric origin, generating from moisture suddenly in aerial storms, but that the stones come from ultra-terrestrial regions, and are, in short, a species of meteor of cosmic origin. Sometimes meteors were an accompaniment of hailstorms.

Proposed New Scientific Phrases.—Some scientific journals propose that men of science should be called "scientiates," and not "scientists," and that instead of using the phrase "scientific studies," we should rather employ "sciential studies." No doubt these changes would harmonize our expressions very closely with the Italian *scienziati* and *scienziali*, but it is exceedingly questionable whether the adoption of these new words would add much to precision of statement, when the words now in use have very definite meanings attached to them.

Obstacles to the Cultivation of Science.—The *Popular Science Monthly* rightly says: "Two unregulated and overwhelming passions in this country stifle the growth of science—the intense and absorbing passion for wealth and the universal infatuation for politics. These are great national diseases, not peculiar to America, but malignant in America, and the state of mind they engender makes the systematic cultivation of scientific thought next to impossible."

Germination of Seeds.—Recent investigations have shown the following curious facts relative to the germination of seeds. Of a hundred peas preserved in the free air, ninety afterwards germinated; of a hundred enclosed with air in a sealed tube, only forty-five; while of an equal number shut up in carbonic acid, none proved fruitful. With other seeds, the numbers varied, but the proportions were substantially the same.

A New Incandescent Light.—Mr. Werdermann, whose electrical discoveries have attracted much notice, has just patented a new incandescent lamp. The peculiarity of this lamp consists in the fact that the vacuum, indispensable in all other such lamps, is dispensed with. Mr. Werdermann employs silicium in place of carbon, and he has succeeded in procuring from it better results than if carbon were employed.

Earthquakes, according to M. Daubrée, appear to have their maximum at the new and full moon, and their minimum at the intermediate quarters of the lunation.

Design of Church, Costing $9,000.

The Presbyterian church at Brewsters, Putnam county, N. Y., now building from plans made by J. A. Wood, architect, of 240 Broadway, and which is the subject of the accompanying illustration, is now so far advanced towards completion that its fine lines and proportions begin to be distinguishable. The building will seat three hundred and sixty persons. It is of wood, and is constructed in the most thorough manner.

At either end of the auditorium is an arch and recess, 20 feet wide by 23 feet high; the arch at the rear forms a chancel, in which is located the pulpit. Back of this, on a raised dias, is the organ and choir. To the left is the study, having an outside door, and another communicating with the chancel, the rear of which, by the way, is octagonal, the longer side of the octagon being filled with the organ.

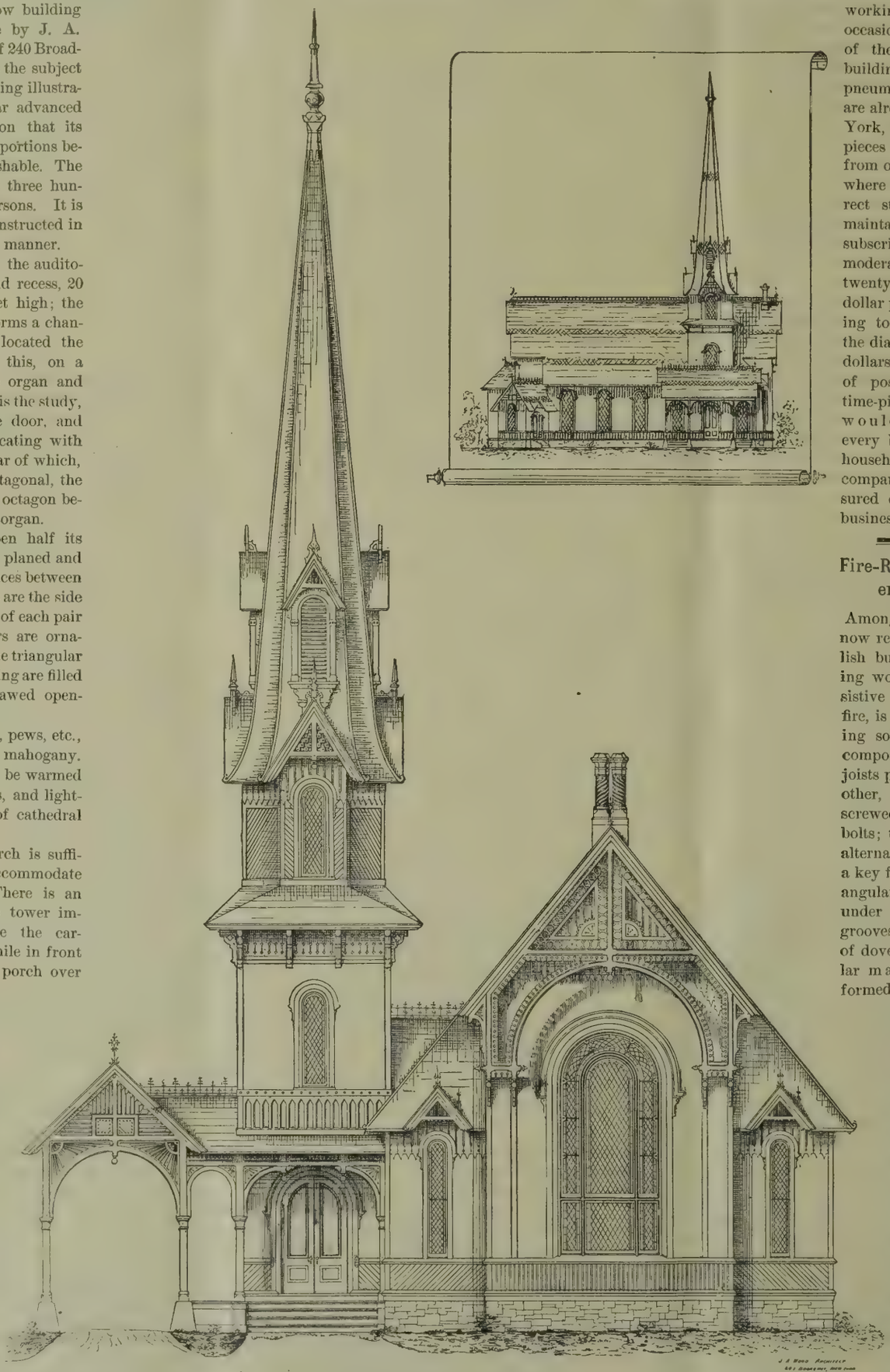
The roof is open half its hight, the timbers planed and chamfered, the spaces between being plastered, as are the side walls. At the foot of each pair of principal rafters are ornamental trusses. The triangular spaces in the framing are filled with chamfered sawed openwork.

The joiner-work, pews, etc., will be of ash and mahogany. The building will be warmed by hot-air furnaces, and lighted with windows of cathedral stained glass.

The carriage porch is sufficiently large to accommodate two carriages. There is an outside door in the tower immediately opposite the carriage platform, while in front is a wide covered porch over the main entrance. All the openings in the frame-work of the carriage porch are filled with sawed work.

The frame is first covered with rough boards, then papered, and finally with upright battened work and diagonal boarding, where shown; the balance with clapboards; all the roofs and the spire with black, green and red slates in ornamental patterns, with ridge railings of iron.

This, like most of Mr. Wood's designs, depends upon its symmetrical lines for effect, nothing of the turned and beaded Eastlake cabinet-maker's inventions being discernible. The cost of the structure complete, including grading, etc., will be about $9,000. In our January issue we expect to present another ecclesiastical design from Mr. Wood.



PRESBYTERIAN CHURCH.

Standard Time.

A company has been formed in this city for the transmission to subscribers of correct time by means of electric currents from a central regulator clock to dials set anywhere that may be desired. The dials are of very simple construction, containing no machinery except one or two ratchet wheels and an electro-magnet, and nothing is necessary to keep them in working order except the occasional replenishing of the battery in each building. Unlike the pneumatic clocks, which are already in use in New York, the electric timepieces will be regulated from one central station, where an absolutely correct standard will be maintained. The cost of subscription is to be very moderate, varying from twenty-five cents to one dollar per month, according to the character of the dials used. At three dollars a year, the luxury of possessing a correct time-piece is one that would seem cheap to every business man and householder, and the company may rest assured of having all the business that is desires.

Fire-Resisting Wooden Flooring.

Among the various plans now resorted to by English builders for rendering wooden flooring resistive to the action of fire, is that of constructing solid timber floors, composed of ordinary joists placed close to each other, and spiked or screwed at intervals with bolts; the latter are fixed alternately, and, to form a key for the plastering, angular grooves are cut under each joist, these grooves forming a series of dovetails. In a similar manner, stairs are formed by a series of joists screwed or spiked together. With regard to partitions, preference is given by many to the French plan of constructing them with quarterings, filled in with rough stone rubble, then lathed on each side with strong laths, and a coat of plaster applied and pressed through the vacuities from each side. In the construction of roofs, the laying of solid concrete flat on iron joists, or iron joists fixed to the inclination of the roof, and then filled in with concrete on the French system, covered with asphalt, is a method highly approved.

American builders may find these modes of construction worthy of imitation.

Market Report of Building Materials.

NEW YORK PRICES.

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LUMBER.

Pine, very choice and extra dry, ₱ M	$65 00 @ 75 00
Pine, good	55 00 @ 60 00
Pine, shipping box	21 00 @ 22 50
Pine, common box	18 00 @ 20 00
Pine, common box ⅝	16 00 @ 18 00
Pine, tally plank, 1¼, 10 inch, dressed each	— 44 @ — 50
Pine, tally plank, 1¼, 2d quality	— 35 @ — 38
Pine, tally plank, 1¼, culls	— 28 @ — 30
Pine, tally boards, dressed, good	— 30 @ — 32
Pine, tally boards, dressed, common	— 25 @ — 28
Pine, tally boards, culls, dressed	— 24 @ — 25
Pine, strip boards, merchantable	— 18 @ — 20
Pine, strip boards, clear	— 24 @ — 26
Pine, strip plank, dressed, clear	— 33 @ — 35
Spruce boards, dressed	— 25 @ — 28
Spruce plank, 1¼ inch, dressed	— 28 @ — 30
Spruce plank, 2 inch, dressed	— 43 @ — 45
Spruce wall strips	— 15 @ — 16
Spruce timber, ₱ M	20 00 @ 22 00
Hemlock boards, ₱ M	17 00 @ 18 00
Hemlock joist, 2½x4, each	— 16 @ — 17
Hemlock joist, 3x4	— 18 @ — 20
Hemlock joist, 4x6	— 40 @ — 44
Ash, good, ₱ M	55 00 @ — —
Oak	60 00 @ 65 00
Maple culls	25 00 @ 30 00
Maple good	45 00 @ 50 00
Chestnut	48 00 @ 52 00
Cypress, 1, 1½, 2, and 2½-inch	35 00 @ 40 00
Black Walnut, good to choice	125 00 @150 00
Black walnut, ⅝-inch	85 00 @100 00
Black walnut, selected, and seasoned	150 00 @175 00
Black walnut, counters, ₱ ft	— 22 @ — 28
Black walnut, 5x5	150 00 @160 00
Black walnut, 6x6	160 00 @170 00
Black walnut, 7x7	175 00 @180 00
Black walnut, 8x8	175 00 @180 00
Cherry, wide, ₱ M	100 00 @120 00
Cherry, ordinary	60 00 @ 80 00
White wood, inch	45 00 @ 50 00
White wood, ⅝-inch	35 00 @ 40 00
White wood, ⅝ panels	42 00 @ 45 00
Shingles, extra sawed pine, 18-inch	4 50 @ 5 50
Shingles, clear sawed pine, 16-inch	4 00 @ 4 50
Shingles, cypress, 24x6	18 00 @ 20 00
Shingles, cypress, 20x6	11 00 @ 12 00
Lath, Cargo rate	2 40 @ 2 45
Yellow dressed pine flooring	30 00 @ 40 00
Yellow pine girders	32 50 @ 40 00
Locust posts, 8 feet, ₱ inch	— 18 @ — 20
Locust posts, 10 feet	— 24 @ — 25
Locust posts, 12 feet	— 29 @ — 34
Chestnut posts, ₱ ft	— 3 @ —3½
Basswood ₱ M	25 00 @ 30 00

Cargo rates 10 ₱ cent off.

CEMENT—PER BARREL.

Portland (imported)	2 65 @ 2 85
Portland (American)	2 30 @ 2 75
Portland (Lafarge)	3 60 @ 3 75
Lime of Teil	2 30 @ 2 50
Lime of Teil, ₱ ton	15 00 @ 18 00
Roman	3 00 @ 3 25
Keene's & Martin's, coarse	9 50 @ 10 00
" fine	12 00 @ 13 00
Rosendale	1 25 @ 1 30

SOLDERS.

Half and half	16 @ — 16¼
Extra	14½ @ — 14¾
No. 1	13 @ — 13¼

ZINC.—Duty, sheet, ₱ ℔, 2½ cents.

Sheet (cask) ₱ ℔	6¾ @ — 7
Sheet (open)	7½ @ — 8

BRICKS.

	Cargo.		Afloat.
Pale, ₱ M	4 75	@	5 00
Up Rivers	8 75	@	9 00
Jersey	8 00	@	8 50
Haverstraw Bay	9 00	@	9 12½
" " choice	9 25	@	9 50
Favorite Brands	9 75	@	— —
Hollow Fire-Clay Brick	9 00	@	9 25

FRONTS.

Croton—Brown, ₱ M	11 00 @ 13 00
" Dark	13 00 @ 15 00
" Red	13 00 @ 15 00
Philadelphia, on pier	30 00 @ — —
Trenton "	30 00 @ — —
Baltimore "	38 00 @ 40 00
Clark's Glens Falls, White	30 00 @ — —
" " Red Fronts	27 50 @ — —
" " Molded Red and White	45 00 @ 80 00

Yard prices 50 cents ₱ M higher, or with delivery added $2 ₱ M for hard and $3 ₱ M for front brick. For delivery add $5 on Philadelphia, Trenton and Glens Falls and $6 on Baltimore brick.

STONE.—Cargo Rates Delivered in New York.

Amherst Freestone, No. 1, in rough, ₱ c. f	1 00 @ — —
do do No. 2	85 @ 95
Bedford Stone	1 25 @ — —
Berlin Freestone, in rough	75 @ 1 00
Berea Freestone, in rough	75 @ 1 00
Brown Stone, Portland, Conn	1 00 @ 1 35
Bay of Fundy Wood Point Brown Stone	1 00 @ — —
do Mary Point Brown Stone	1 00 @ — —
do do Olive Stone	1 00 @ — —
Brown Stone, Belleville, N. J	1 00 @ 1 35
Granite, rough	60 @ 1 25
Canaan Marble	1 25 @ 1 50
Sutherland Falls Marble	1 25 @ 1 75
Dorchester, N. B., Stone, rough, ₱ foot	1 00 @ — —

LEAD—PER 100 POUNDS.

German	— — @ — —
English, common	— — @ — —
Spanish	5 75 @ — —
Foreign, refined	— — @ — —
Bar	6 50 @ — —
Sheet	7 50 @ — —
Pipe	— — @ — —
Domestic	4 63 @ — —

SLATE.

Purple, roofing slate, ₱ square	$7 00 @ 8 00
Green Slate	7 00 @ 8 00
Red Slate	15 00 @ — —
Black Slate, Pennsylvania, (at Jersey City)	4 75 @ 5 25
Slate tiles, 1¼-inch, rubbed, ₱ square foot	20 @ 25

TIN PLATES.—Duty, 1⅐₁₀ cents ₱ ℔.

I. C. charcoal, 10x14, ₱ box	6 25 @ 6 75
I. C. coke, 10x14	5 25 @ 5 75
I. X. charcoal, 10x14	8 25 @ 8 37½
I. C. charcoal, 14x20	6 25 @ 6 75
I. X. charcoal, 14x20	8 25 @ 8 37½
I. C. coke, 14x20	5 25 @ 5 75
I. C. coke, terne, 14x20	5 25 @ 5 37½
I. C. charcoal, terne, 14x20	5 37½@ 5 75

NAILS—PER KEG.

10d to 60d, common, fence and sheathing	3 30 @ 3 40
8d and 9d, common	3 65 @ — —
6d and 7d, common	3 90 @ — —
4d and 5d, common	4 15 @ — —
3d and 4d, light	4 95 @ — —
3d, fine	5 65 @ — —
2d, fine	5 65 @ — —
Cut spikes, all sizes	3 65 @ — —
Clinch nails, 1½ to 1¾ inch	5 65 @ — —
do. 2 to 2¼ inch	5 40 @ — —
do. 2½ to 2¾ inch	5 15 @ — —
do. 3 inch and longer	4 90 @ — —

IRON—PER TON.

Duty.—Bar, 1 to 1½c. ₱ ℔. ; Railroad, 70c. ₱ 100 ℔. ; Boiler and Plate, 1½c. ₱ ℔. ; Sheet, Band, Hoop, and Scroll, 1¼ to 1¾c. ₱ ℔. ; Pig, $7 ₱ ton ; Polished Sheet, 3c. ₱ ℔. Galvanized, 2½c. ₱ ℔. ; Scrap cast, $6 ₱ ton ; Scrap Wrought, $8 ₱ ton—all less 10 ₱ cent. No Bar Iron to pay a less duty than 35 ₱ cent ad val.

Pig, Scotch—Coltness	26 50 @ 27 50
" Glengarnock	23 50 @ 24 50
" Eglinton	22 50 @ 23 50
" American, No. 1	25 00 @ 26 50
" American, No. 2	23 00 @ 24 25
" American forge	21 00 @ 22 50

PAINTS.

Carmine, American, ₱ ℔	5 00 @ 5 25
Chalk, ₱ 100 ℔s	— 35 @ — —
China Clay, ₱ ton	18 00 @ 20 00
Chrome yellow, dry, ₱ ℔	— 12½ @ — 28
Lead, red American, ₱ ℔	— 6¾ @ — 7
Lead, white American, pure, in oil	— 7½ @ — 8
Lead, white American, pure, dry	— 6¾ @ — 7
Lead, white English, pure, in oil	— 9 @ — 10
Litharge	— 6¾ @ — 7
Ocher, Fr., dry, ₱ 100 ℔s	1 50 @ — —
Ocher, ground, in oil, ₱ ℔	— 6 @ — 15
Ocher, Vermont, ₱ 100 ℔s	— 75 @ 1 00
Orange Mineral, English	— 9 @ — 10
Paris White, American	— 1½ @ — 1¾
Paris White, English, prime	— 2 @ — 2¼
Paris Green	— 15 @ — 28
Plumbago paint, patent, ₱ ℔	— — @ — 25
Putty, ₱ ℔	— 2 @ — 2½
Spanish Brown, dry, ₱ ℔	— 1⅛ @ — 1¼
Spanish Brown, ground in oil, ₱ ℔	— 8 @ — 9
Venetian red, ₱ cwt	1 75 @ 2 00
Vermilion, Chinese, ₱ ℔	— 85 @ — 90
Vermilion, Trieste	— 70 @ — 75
Vermilion, quicksilver, bags	— 50 @ — 52½
Vermilion, American, common	— 15 @ — 18
Whiting, ₱ 100 ℔s	— 60 @ — 80
Zinc, white American, dry, No. 1	— 5 @ — 7½
Zinc, white American, No. 1, in oil	— 8 @ — 10
Zinc, white French, dry, (Red Seal)	— 7 @ — 8
Zinc, white French, in oil	— 10 @ — 10½

VARNISHES—PER GALLON.

American Wearing Body	3 50 @ 4 00
Coach Body	2 35 @ 3 50
"	1 80 @ 2 00
Furniture	1 25 @ 2 50
Black Asphaltum	1 00 @ 1 50
Brown Japan	1 00 @ 1 20
Liquid Paint Dryer	1 35 @ 1 75
Harness, (black)	3 00 @ 4 50
Shellac, Spirits	3 00 @ 3 50

LIME—PER BARREL.

State, common	— 95 @ 1 00
" finishing	1 10 @ 1 15
Rockland, common cargo rate	1 10 @ — —
" finishing	1 20 @ — —
Ground	— 90 @ 1 00

Add 25 cents to above figures for yard rates.

HAIR.

Cattle, ₱ bushel of 7 ℔s	— 18 @ — 21
Goat " "	— 33 @ — 35

PLASTER PARIS.

Duty.—20 ₱ cent ad. val. on calcined ; lump free.

Calcined, ordinary city, ₱ bbl	1 30 @ 1 35
Calcined, city casting	1 50 @ 1 65
Calcined, city superfine	1 70 @ 1 75

MAHOGANY.

St. Domingo, crotches, ordinary to good, ₱ ft	— 15 @ —20
St. Domingo, crotches, fine	— 20 @ —30
St. Domingo, logs, small	— 5 @ — 8
St. Domingo, logs, large	— 8½@ —14
Frontera, Mexican, large	— 12 @ —15
Frontera, Mexican, small	— 6 @ — 8
Other Mexican	— 9 @ —11
Honduras	— 6 @ —12½
Rosewood, ordinary to good, ₱ ℔	— 2½ @ — 4½
" good to fine	— 5 @ — 8
Satin Wood, ₱ foot	— 15 @ — 75
Tulipwood, ₱ ℔	— 6 @ — 7
Lignumvitæ, large, ₱ ton	30 00 @ 50 00
Lignumvitæ, other sizes	10 00 @ 25 00

CEDAR.

Cuba and Mexican, small, ₱ super. ft	6 @ — 7½
Cuba and Mexican, medium	8 @ — 9½
Cuba and Mexican, large	10 @ —11
Florida, ₱ cubic foot	40 @ —75

DEADENING AND ROOFING MATERIAL.

Mineral wood for Roofs and deadening, ₱ ℔	— 1¼ @ —1½

LABOR.

Ordinary, ₱ day	2 00 @ 2 50
Masons, do	3 50 @ 4 00
Plasterers, do	4 00 @ — —
Carpenters, do	4 00 @ — —
Plumbers, do	4 00 @ 4 50
Painters, do	3 00 @ 3 50
Stone-Cutters, do	3 00 @ 3 50

REVIEW OF THE MARKETS.—In the lumber market the past month, in the way of distribution for consumption, new business has been moderate but old business has continued very fair. That is to say, the deliveries still making on contract have been taking out quite a little amount of stock, but beyond this sellers have not found many anxious customers, nor is it very likely that the situation will undergo much change until after the holidays. Exporters have afforded some relief, but have still kept close to the limit of direct and positive orders.

In the brick market the position is at present a little unsettled. This seems to be due to some excess of supply over demand. The consumption has modified through various causes, and contractors in consequence have been less liberal buyers, while at the same time the arrivals have been full and cargoes accumulated slightly. The latter seems to be due to the fact that the late freeze and snow-storm gave a decided hint of the advance of the season, and manufacturers at once availed themselves of a fair supply of freight room within reach to push forward shipments from all points.

In the lime market all offerings have been readily disposed of, with some demand for parcels afloat, and full former figures have been firmly maintained. Indeed, sellers appear to have had all the advantage, as advices received reported the kilns at the Eastward all shutting down, with the shipments to cease as soon as the small supply on hand was loaded, which, of course, ends the season. The State kilns, also, have stopped, the canals are closed, and agents report very little as likely to come forward by rail.

In the lath market there is really nothing new since our last. Buyers have complained somewhat over the cost, which continues to harden, but have gained no advantage, as actual wants have been in excess of the supply, and receivers have manifested considerable indifference about operating even when met by encouraging bids. Offerings on spot have amounted to nothing, and there has been very little afloat.

In the cement market domestic grades have been held very firmly, and the advantage has been almost wholly in sellers' favor. Accumulated stocks are very small. There has been demand enough to exhaust the current arrivals of standard brands when the rate was low enough from pier to prevent competition from stored goods, but the latter have not been called for at rates giving holders a clear margin, and have had to be carried to await developments.

In the hardware market, beyond some little local trade and an occasional order from near-by points, the business in general hardware has amounted to almost nothing, and the market has been extremely dull. A portion of the trade have assumed a tone of steadiness and have sought to keep up as good an appearance as possible, but the market has evidently been far from satisfactory, with little or no chance for improvement until after the holidays.

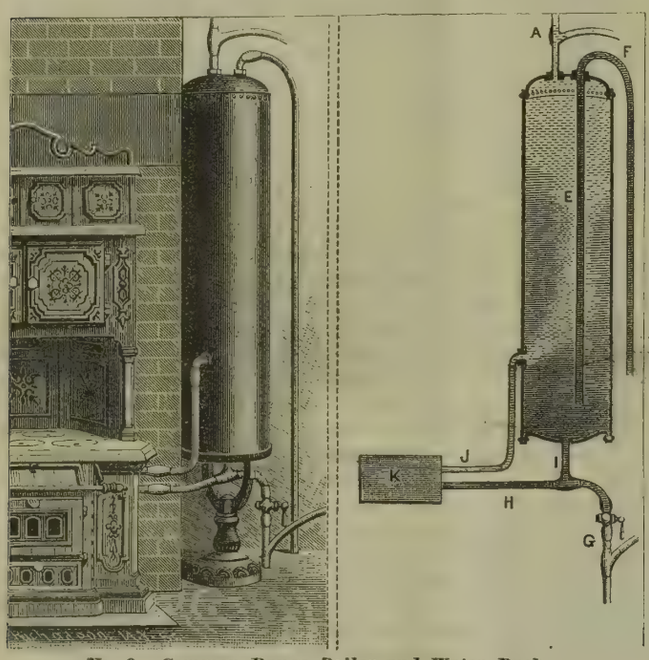
In the metal markets Scotch pig has been dull, with prices weak and unsettled. There has been a considerable pressure to realize on lots now afloat. American pig has continued to meet with slow and uncertain sale, the general indications favoring the buyer. On first-class brands sellers have given way rather, but ordinary stock has been urged. Manufactured iron has been nominally unchanged, with a fair jobbing business doing. Domestic pig lead has met with very little inquiry from any quarter, and while holders have refrained from direct pressure to realize, the supply appears to have outbalanced the demand, and prices have been weak all around. Pig tin has been dull and unsettled, but with a general tendency in buyers' favor, neither the condition of trade abroad nor here affording much encouragement. Tin plates secured more or less of a jobbing demand, but supplies greatly exceeded the wants of the market, and the tone was weak on pretty much all qualities. Sheet zinc has been dull but steady.

In the paint market nothing worthy of special notice has developed. Demand has amounted to little, and has been confined in the main to regular trade orders, against which the available supply was ample and well enough assorted, with holders willing to negotiate on a basis of former figures.

Improvements in Range Boilers.

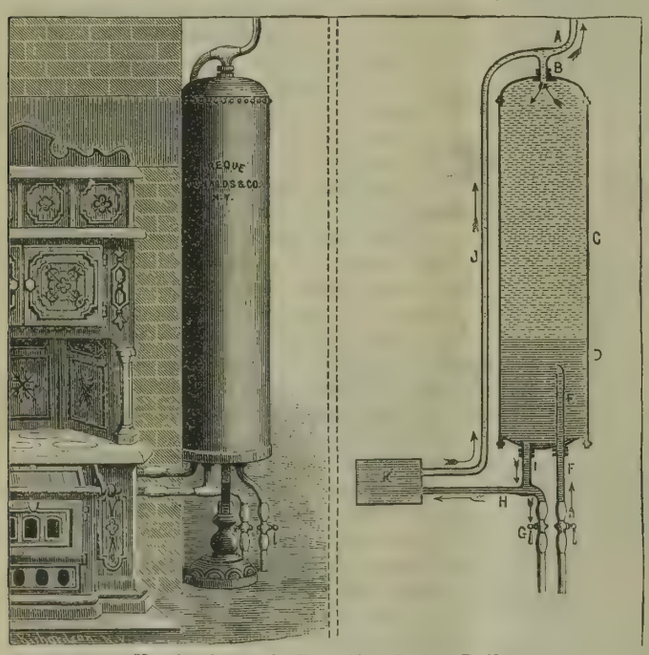
We offer in the accompanying article, with suitable illustrations, some additional facts respecting the improvements in the construction of range boilers, referred to in one of our recent issues. The improvements that will be spoken of here, like the others, represent the inventions and manufactures of Messrs. Creque, Ronalds & Co., corner of Beekman and Cliff streets, this city. The principles involved in these improvements are well illustrated by the engravings, which in each case show the device in elevation and in section.

No. 0 shows the common form of range boiler and its connections, a few preliminary explanations concerning which will enable our readers to fully comprehend the value of the improvements which will be described further on. Referring, then, to the sectional view of boiler No. 0, K represents what is commonly called the "water-back," consisting of a closed cast-iron box placed in the back of the fire-box of the range, taking the place of one or several of the fire bricks. It is provided with two openings, into which the pipes J and H are secured. The first communicates with the boiler some little distance from the bottom, as seen in the cut, while the other connects the water-back with the bottom of the boiler and with the water supply. The boiler, it will be seen, is constantly full of water. When the water-back is heated, it communicates its heat to the water within it, and the heated water, being specifically lighter, rises through the pipe J into the boiler, where it at once rises to the top, cold water from the lower portion passing through I and H into the water-back to take its place. The objection to this arrangement is obviously this, that the heated water entering through I, is obliged to impart its heat to a large body of cold water, and consequently loses most of its heat before reaching the highest point of the boiler. The entire body of water by this means is uniformly and slowly heated, the operation requiring considerable time.



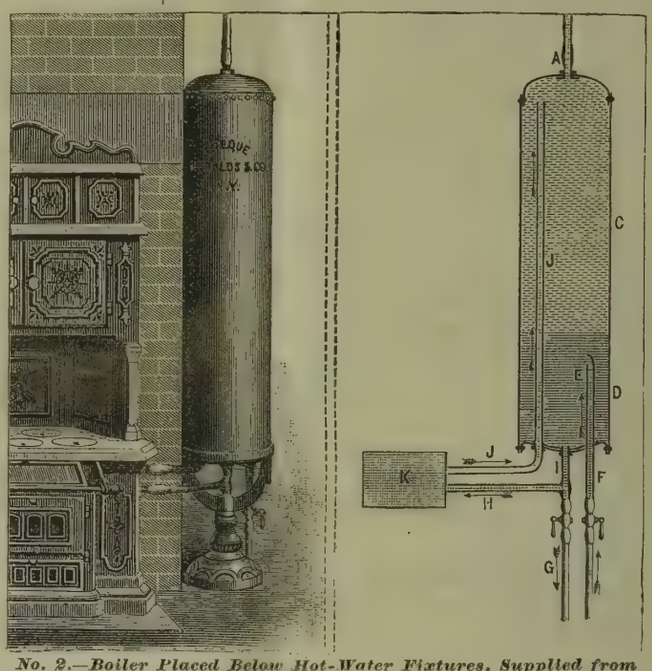
No. 0.—Common Range Boiler and Water-Back.

In the various modifications of the system introduced by Mr. Creque, this objection is met and obviated by carrying the induction pipe conveying the heated water, to the very top of the boiler. By this artifice the hot water has no opportunity of mixing with the cold water in the boiler, as in the ordinary arrangement, but at once accumulates in a layer at the top, and, as the circulation goes on, rapidly increases in thickness. By this means it becomes possible, within a very few minutes, to draw hot water from the boiler. The difference in the specific gravity of the heated and the cold water causes the former to float on the surface of the latter, and the line dividing them is always sharply defined.



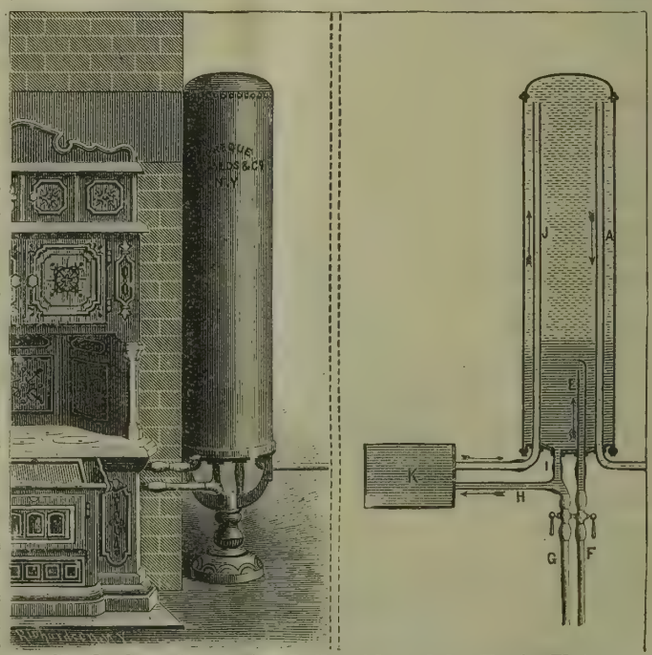
No. 1.—Creque's New Circulation Boiler.

The boiler marked No. 1 represents one of the several forms embodying this improvement. In this, it will be observed, the hot-water induction pipe J is carried to the very top of the boiler. By this arrangement not only is a body of hot water secured with the least possible delay, but the circulation is greatly facilitated; for as the degree of the circulation will depend on the difference in the weight of the hot and cold columns of water, it will be noticed in the old arrangement the hight of this column is but slight, while in the new one the hight, or the distance between the levels H and A, is several times greater. This incidental advantage is of considerable utility, since with more powerful circulation, not only is heating more rapidly effected, but it more readily overcomes the frictional resistance of long connections, bends and the like, which often seriously hamper the efficiency of the old arrangements.



No. 2.—Boiler Placed Below Hot-Water Fixtures, Supplied from Street Main.

Referring again to boiler No. 1, we may explain that the water supply from the service pipe enters the boiler through the pipe F, and is delivered through pipe E at a point near the bottom; the top of this pipe is carried over in order that the cold entering water shall not be shot upwards into the hot water, but shall distribute itself horizontally. The branch pipe G connecting with pipe I extends through the floor, and is controlled by a cock. It is connected either with the sewer or the sink, and its purpose is to empty the boiler whenever it may be found necessary. The difference in the shading in the figure is intended to show the lighter heated water floating on the surface of the cold water. Whenever the faucets are opened hot water is forced out at A, by the pressure of the cold water from the service pipe outside



No. 3.—New Circulation Boiler Adapted for Use in Flats.

It will be obvious, too, that with this construction, it will not be necessary to wait until the whole body of the water in the boiler becomes uniformly heated before hot water can be delivered, as the delivery of the hot water into the top of the boiler permits of its immediate accumulation.

Boiler No. 2 shows a modification of the same system, in which the hot-water induction pipe J J is brought up inside of the boiler to the top, whence it is delivered through the pipe A wherever it may be needed. The other connections are substantially the same as in boiler No. 0.

No. 3 shows still another modification, which is specially adapted for apartment houses, or other situations where it may not be desirable or convenient to have the hot-water delivery above the level of the boiler. In this arrangement both the hot-water induction and delivery pipes are introduced into the bottom of the boiler, and extend to near its top, the other connections remaining the same.

No. 4 differs from No. 3, in having the hot-water induction pipe carried outside of the boiler to the top, as in No. 1, the delivery pipe being at the bottom.

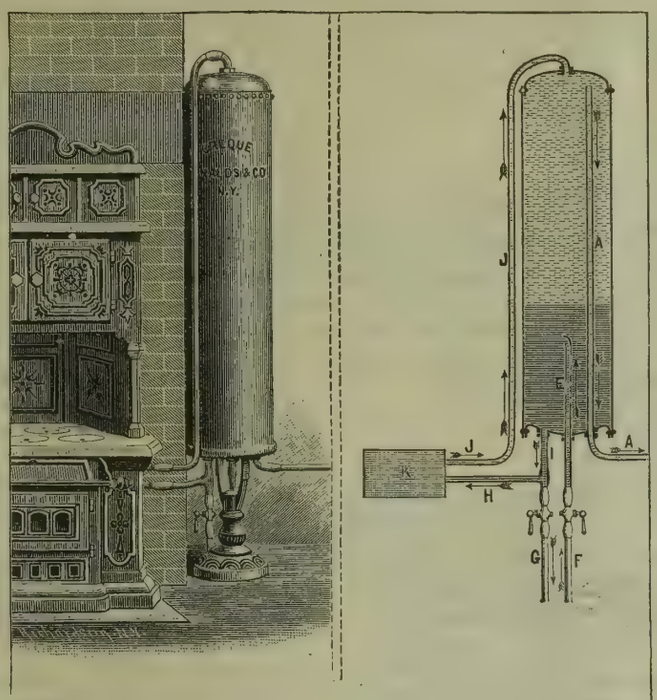
No. 5 is a modification intended for the accommodation of country houses, and the like, where the water supply is derived from an overhead tank or cistern. In this case the cold-water pipe F F brings the supply to the water-back from above, the hot-water induction and delivery pipes being both carried up inside the boiler.

No. 6 represents still another modification, designed for similar situations, in which the cold-water supply from the tank, etc., enters by a pipe passing through the top of the boiler to a point near the bottom; the hot-water induction pipe is internal, as in Nos. 2, 3 and 5, and the hot-water delivery pipe extends externally from the top of the boiler.

It will readily be perceived that the modifications of which this ingenious system is susceptible are very numerous. In all cases, the choice of the best plan will be decided by the situation and other attendant circumstances, the object being always to simplify the plumbing as far as possible, and to adopt the modification that seems best adapted.

The merits of this very practical system of construction are too obvious to require further elaboration at our hands. The engravings tell their own story.

Those of our readers desiring special information for particular cases, are invited to communicate with the manufacturers, whose address is given above.

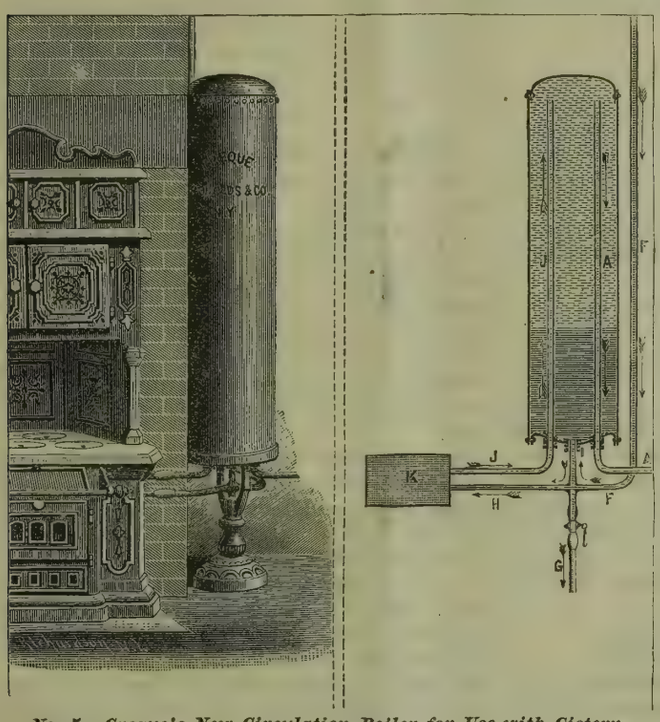


No. 4.—New Circulation Boiler, Especially Adapted for Apartment Houses.

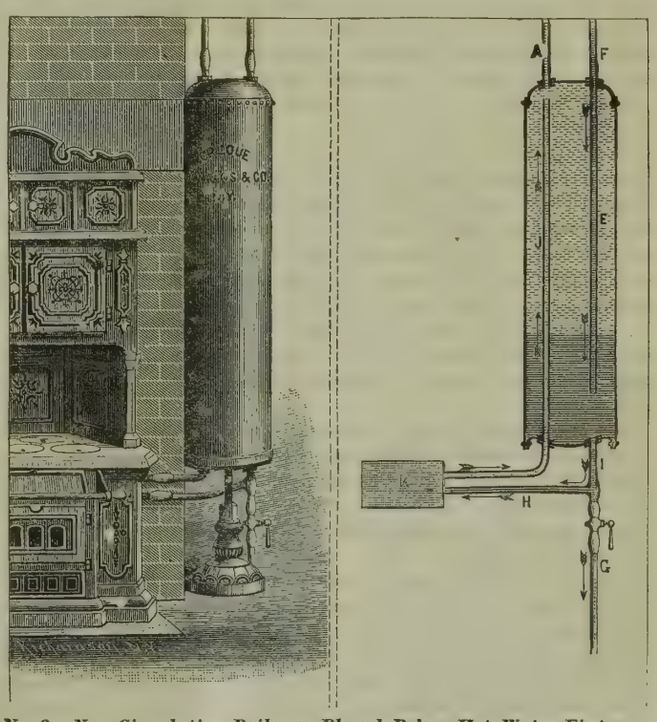
The Hight of Buildings.

The commission charged with revising the building regulations of Paris, have prepared a plan for restricting the hight of buildings to correspond with the width of streets. For streets 25 feet wide, houses may be 40 feet high, approximately, and thence the hight increases with the width of the street up to 65 ft. for streets of the same or greater width. In the last case it is provided that there shall not be more than five floors above the ground floor, including the *entresol*, or middle story, thus doing away with the low, dark *entresol* of the present style of buildings. Each building of the last class must also have an interior courtyard of not less than 40 square meters area, the opposite sides of which shall in no case be nearer than 4½ meters, nor the angles between two contiguous sides less than 60°. The courtyard will not be obligatory in the case of buildings facing on several streets and entirely filling up the space between said thoroughfares.

The passages, vestibules and corridors must be well ventilated and lighted, while, as respects the interior courtyards and small courts, it is enacted, (1) that every court serving solely to light the kitchens must be of at least 8 meters surface, with not less than 60° angle between contiguous ones; (2) that every court serving solely to give light and air to the water-closets, must be of at least 4 meters surface, with not less than 1 meter 60 centimeters distance between opposite sides, nor less than 60° angle between contiguous ones. Finally, every court that has no communication with the street, must be ventilated from the bottom.



No. 5.—Creque's New Circulation Boiler for Use with Cistern.



No. 6.—New Circulation Boiler as Placed Below Hot-Water Fixtures.

The Loiseau Artificial Fuel.

Much interest has been aroused by the exhibition, at the late fair of the American Institute, of the artificial fuel manufactured from anthracite coal dust by the Loiseau Fuel Co., of Philadelphia; and this interest has been intensified by the excellent showing made by the artificial coal in comparison with natural coal, in a series of tests of two Babcock & Wilcox boilers, which were made during the continuance of the exhibition under the superintendence of Prof. J. E. Denton, of the Stevens Institute of Technology.

So far as concerns heating power, coherence in the furnace, ability to withstand transportation and handling, the artificial fuel is all that could reasonably be expected, and in these and other qualities by which a good fuel is judged, the Loiseau artificial fuel will bear favorable comparison with natural fuel. Mr. Loiseau has devoted the last fifteen or more years of his life to the solution of the problem of profitably converting the waste of anthracite coal into a commercial fuel suitable for domestic and manufacturing uses; and after encountering difficulties, reverses and failures that would have utterly disheartened most men, he appears at length to have successfully mastered the problem. He has erected extensive works in Philadelphia, supplied with machinery of special design, capable of turning out a large daily output; and the artificial fuel is steadily gaining in popularity as its excellent qualities are becoming generally known. For his persistence after so many vicissitudes, Mr. Loiseau has amply deserved the success, which, from all appearances, has at last crowned his efforts in inaugurating in this country an industry that has long been successfully established in Europe.

The artificial fuel industry in Europe appears to be

confined almost entirely to the production of a fuel suitable for steaming purposes, the "briquettes," as the lumps are called, being generally produced of sizes weighing from 3 to 40 pounds. The production of lumps of small size, such as are required for domestic uses, appears to have been unsatisfactory, owing to difficulties of a mechanical and economical nature. The best form of European machine thus far devised for the purpose of manufacturing artificial fuel from coal waste in sizes suitable for domestic uses, is said to be of French origin, and to have received the recognition of a gold medal at the last Paris exhibition. Its capacity is 98 tons in 24 hours, the lumps weighing nearly 3½ pounds.

The machinery designed by Mr. Loiseau, and which has been for some months in successful operation, is capable of producing artificial fuel in lumps of any desired size, suitable either for manufacturing or domestic purposes. The lumps can be made to vary in weight from 2 ounces to 1 pound, the first named size being at present manufactured extensively for household use. According to its size, the production of the press varies from 75 to 300 tons per day of 10 hours.

Mr. Loiseau's process of manufacture, which we hope to describe in detail in a future article, is adapted to the production of artificial fuel from the waste of anthracite or bituminous coal, coke, brown coal or lignite. The resulting product, in the form of egg-shaped lumps, will not crumble, but will retain its shape in the fire until consumed. Different proportions of all kinds of coal dust can be mixed together and compressed into lumps to suit the requirements of modern industry. By the same machinery, rejected ores, such as the washings of hematite ore, the granulated ores, the black sand ores, can be solidified. Ores of all kinds can be pulverized, mixed with coal dust and fluxes in required proportions, then compressed, and the metals which these ores contain, it is claimed, can thus be obtained of a more regular and better quality, and at less cost, than by the processes now applied. The ores can be pulverized either in their raw state or after being roasted and freed of most of the impurities by washing, before being compressed. The inventor affirms his ability, by his mode of procedure, to produce wrought iron direct from the ore.

The tests made by Prof. Denton, to which we referred at the outset of this article, gave an exceptionably good opportunity of testing both the physical character and the heating power of the Loiseau fuel, and the results were of a most satisfactory character, as the following facts, gleaned from his report, will bear testimony. These tests, it should be remembered, were made primarily to determine the duty of the boilers, the comparative tests of the anthracite and artificial coal employed, being incidental to the main purpose.

The boilers tested were of the Babcock & Wilcox pattern, two in number, and the tests were made with natural and forced draught, the latter supplied by a Sturtevant blower. The heating surface of the two boilers was 2,808 square feet; grate surface, 70 square feet; ratio of heating surface to grate surface, 40; and the least draught area, 10 square feet. Allowance was made for water evaporated by the injector, in computing the quantity of water evaporated. The following table gives the actual results of the test of the different fuels, no allowance being made for any of the variations in the conditions affecting the result:

WATER EVAPORATED PER POUND OF FUEL.

	Ash. Per cent.	*Steam Pressure. Pounds.*	*Temperature feed-water.*	*Temperature waste gases.*	*Water evaporated. Pounds.*
Loiseau fuel, natural draught	15.0	85	160	375	7.74
" " forced draught	15.0	92	165	438	7.00
Anthracite coal, natural draught	25.5	75	153	236	7.40
" " forced draught	26.0	85	160	400	6.14

The superiority of the artificial fuel over the other is very noticeable. A more accurate comparison of the efficiency of the two fuels appears in the following table, calculated from the one above given, and in which the allowance is made for the difference in the temperature of the feed-water. The figures have been calculated so as to show how much water would have been evaporated if the feed-water had been supplied at the temperature of boiling water, or 212° F. The second set is calculated for feed-water supplied at 212° F., and steam pressure at 14.7 pounds per square inch:

	Water evaporated— Steam pressure at	*Pounds of water.*	*Steam pressure at*	*Pounds of water.*
Loiseau fuel, natural draught	85	8.12	14.7	8.35
" " forced draught	92	7.32	14.7	7.56
Anthracite coal, natural draught	75	7.80	14.7	8.10
" " forced draught	85	6.44	14.7	6.69

By making an allowance for the ash, and calculating the evaporation per pound of combustible for the two different fuels, the three rates of evaporation become:

EVAPORATION PER POUND OF COMBUSTIBLE.

	Temperature waste gases.	*Actual.*	*From 212° feed.*	*From and at 212° feed.*
Loiseau fuel, natural draught	375	9.14	9.59	9.87
" " forced draught	438	8.20	8.60	8.90
Anthracite coal, natural draught	236	9.93	10.47	10.87
" " forced draught	400	8.30	8.70	9.04

We have again added the temperature of the waste gases, to show how close is the relation between it and the evaporation. The following calculation affords a comparison of the steaming capacity of the boilers with the different kinds of fuel, as measured by the water evaporated per hour per square foot of heating surface:

STEAMING CAPACITY.

	Actual.	*From 212° feed*	*From and at 212° feed.*
Loiseau fuel, natural draught	3.86	3.97	4.08
" " forced draught	5.06	5.29	5.48
Anthracite coal, natural draught	2.72	2.89	2.97
" " forced draught	4.60	4.82	5.01

To make the comparison an accurate one, allowance is made in the above table for the difference in ash between the two fuels, by adding in the figures 15 per cent to the artificial fuel and 25 per cent to the anthracite coal.

Summarizing the results of the tests, it will be apparent that the artificial fuel burns faster, and therefore makes more steam in a given time with a given area of grate, and this is particularly so with natural draught. The result, of course, is that the horse-power of the boiler is increased. The following comparison of figures from the reports of Prof. Denton will clearly illustrate this. We have again added 15 and 25 per cent respectively:

HORSE-POWER OF BOILERS.

	Actual.	*From 212° feed.*
Loiseau fuel, natural draught	361.1 H.P.	379.5 H.P.
" " forced draught	492.3 H.P.	517.5 H.P.
Anthracite coal, natural draught	312.4 H.P.(est)	327.4(est.)H.P.
" " forced draught	418.2 H.P.	445.0 H.P.

From the above figures, it will require no explanations to prove to our mechanical readers that the Loiseau fuel has secured a signal triumph. We hope to present in a future article some details of the process of its manufacture. Meantime, those of our readers who may wish for more information, may address themselves to the Loiseau Fuel Co., corner of Bath and Linden streets, Port Richmond, Philadelphia.

The Babcock & Wilcox Boilers.

The continued popularity of the Babcock & Wilcox boilers is shown by the following orders received within the past month: Oliver Wire Works, Pittsburgh, Pa., 416 horse-power; Clark Mile End Spool Cotton Co., Newark, N. J., 1,250 horse-power; New York & Brooklyn Bridge Co., Brooklyn, N. Y., 416 horse-power; Warder, Bushnell & Glassner, Springfield, O., 300 horse-power; Beaver Wire Co., Beaver Falls, Pa., 272 horse-power; Edison Illuminating Co., Lawrence, Mass., 60 horse-power; Edison Illuminating Co. (Bijou Theater), Boston, Mass., 73 horse-power; Edison Electric Light Co., London, England, second order, 150 horse-power; Edison Electric Light Co., Milan, Italy, 656 horse-power; St. Rollox Chemical Works, Glasgow, Scotland, 240 horse-power; McEachran & Adams, sugar refiners, Greenock, Scotland, 122 horse-power; New York Steam Co., New York city, seventh order, 1,000 horse-power; Peters Dash Co., Columbus, O., second order, 244 horse-power; the Solvay Process Co., Syracuse, N. Y., 832 horse power; Solvay & Cie., Wyhlen, Grande Duche de Baden, 480 horse-power; Solvay & Cie., Dombasle sur Murthe, France, 240 horse-power. The Babcock & Wilcox Co. are now prepared to ship on demand any size boiler above 42 horse-power.

Miscellaneous and Advertising.

The George Place Machinery Company, of 121 Chambers street, this city, have always on hand a large line of new and second-hand machinery of every description.

"How to Keep Boilers Clean," and other valuable information for steam users and engineers. Book published by James F. Hotchkiss, 84 John street, New York. Mailed free to any address. (Mention this paper.)

The Tewksbury Automatic Elevator Co., of 60 Temple Court, this city, now have their elevators in working order at Tiffany & Co.'s, the American News Co., and the Knickerbocker Club, in New York, and also have orders to furnish them for R. H. White & Co. and the new *Advertiser* building in Boston.

H. W. Johns' asbestos air-chamber coverings, consisting of asbestos sheathing and lining felt combined with hair felt, for steam pipe and other heated surfaces, is patented, and infringers will be prosecuted to the full extent of the law. H. W. Johns Manufacturing Co., 87 Maiden Lane, New York.

The Walworth Manufacturing Co., of 69 Kilby street, Boston, Mass., employ about 400 men, and their new factory is taxed to the utmost in every department to keep up with orders, consuming monthly about 300 tons of pig iron, 125 tons of wrought iron and steel in various forms, and 50 tons of copper and other metals.

Design for a Cottage, Costing $2,500.

We present our readers with the plans and elevations of a representative cottage for the country within any moderate distance from New York; so called because it supplies the present demands of newly married couples or small families of refinement with sufficient house room for night and day uses, with the addition of conveniences usually allotted to houses of larger cost. We call special attention to these matters only, as the general plans require no formal description, and will be easily followed and understood.

Upon the second story will be seen a convenient bath-room, with provisions for hot and cold water supply, and located between the family bedrooms and child's room.

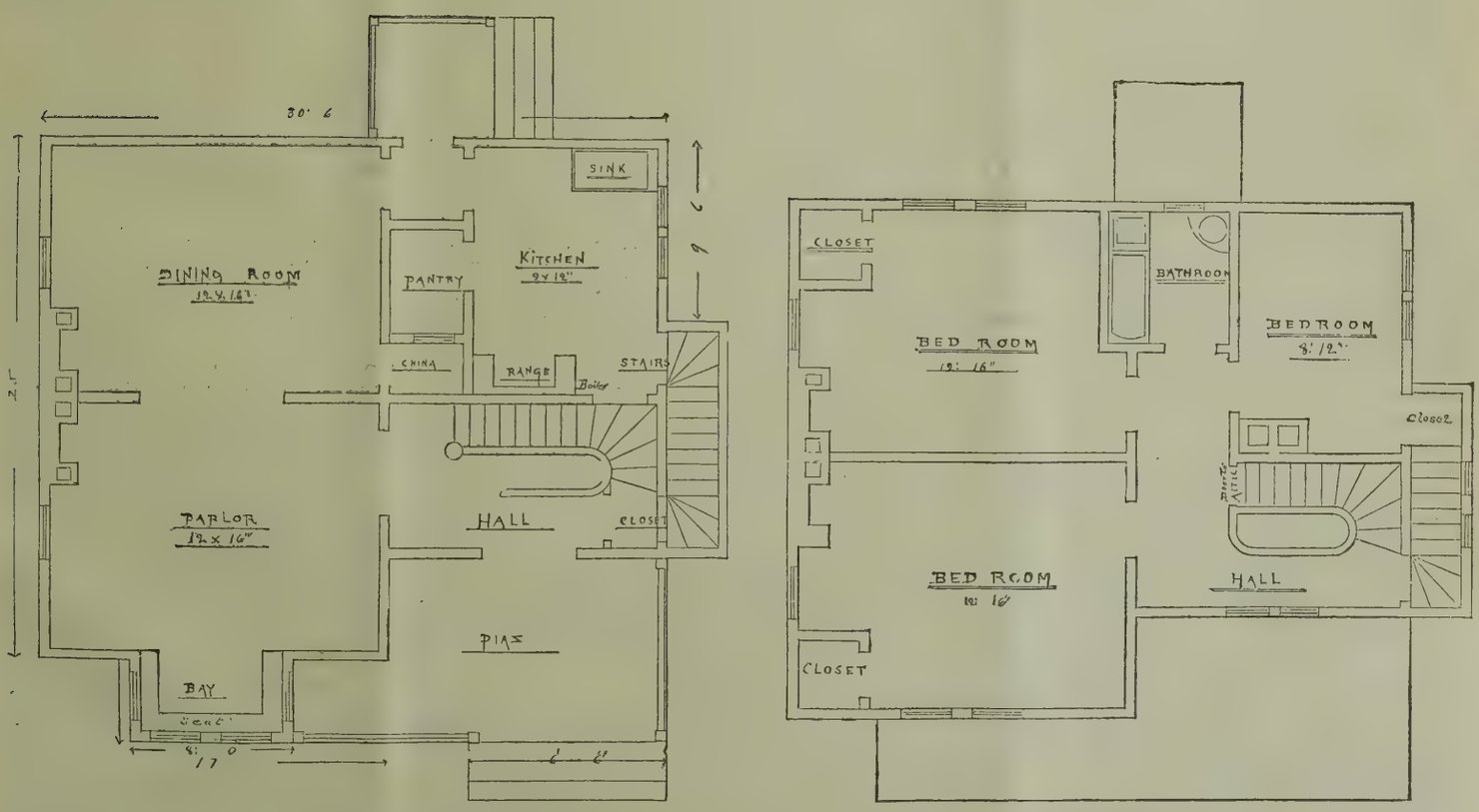
The kitchen has in a compact space the usual appliances of a larger house, with good light and ventilation. The usual brick breast for the range is left out, to save room and expense, and double smoke and ventilating flues arranged and built up to receive the latest invention in the matter of ranges, a portable range with an iron hood, and a ventilating register beneath.

A flight of box stairs renders communication with the attic story easy without passing through the living rooms and hall. This story has, besides the servants' room, two others—one large and one small, making a nine-roomed cottage of good style and construction, estimated to cost, with a plain, tasteful interior of soft wood and plaster finish, about $2,500.

This cottage was recently erected at Rutherford, N. J. The architect is D. T. Atwood, of 335 Broadway, New York.

Front Elevation. Side Elevation.

DESIGN FOR A COTTAGE, COSTING $2,500.



First Story. Second Story.

PLANS OF FLOORS.

Luminous Paint.

The introduction at this time of luminous paint is not the result of any recent discoveries or improvements in its manufacture, for we are told that the substance which Canton prepared was as good as any one can now make. Prof. Tuson, of London, has in his possession some of Canton's own make in a sealed tube, inscribed 1764, which retains its peculiar property to this day. It would seem as if the world was not yet ripe for the discovery, and it lay for more than a century a curious toy in chemical collections. Then all at once it sprung into importance, both technically and for ornamental purposes.

In a lecture before the Berlin Polytechnic Society, Gaedicke gave some details of its history, which may prove of interest.

All the recipes for making the luminous material depend upon the formation of sulphur compounds, sulphides of barium, strontium, or calcium. They either set out with the sulphates, which are reduced in different ways, or with carbonates or oxides, that are treated with sulphur or its compounds.

The Bologonian phosphorus was made, according to John, from pulverized bartyes, free from iron, by mixing it with gum tragacanth to a cake, drying this and heating it for an hour between layers of coal in a wind furnace. Osann reduced the sulphate of barium by igniting it in a current of hydrogen. In 1750 Markgra heated sulphate of lime with charcoal—a method still in use to-day. Canton prepared a phosphorescent sulphur compound of lime, taking as his material burnt oyster shells, which he treated with flowers of sulphur. Grotthus attempted to improve on this method, and Osann modified it by substituting for the flowers of suphur a metallic sulphide which gave up sulphur when heated, such as sulphides of antimony, tin or mercury. Wach returned to Canton's method, but mixed the flowers of sulphur with small quantities of metallic oxides, such as antimony, with the view of obtaining different colors in this way. The color of the light is generally white, or, at first, bluish. Hyposulphite of strontium, or equal parts of carbonates of strontium and sulphur, when ignited for twenty or twenty-five minutes, at first over an ordinary Bunsen burner and then over the blast lamp, give a green light, while carbonate of barium and carbon give an orange-yellow light.

The pure sulphides do not give any light at all. Hence the chemical composition alone does not condition its power of giving out light, since of two substances having the same composition, one may be luminous while the other is not. It seems rather as if the power of giving light depends not only on the correct chemical composition, but also upon a definite molecular condition. Hence it happens that the luminous substance obtained from burnt mother-of-pearl is better than that from burnt oyster shells; also that when slaked lime is the material employed, the result differs from that obtained from aragonite, although in all four cases the resulting substances have the same chemical composition. The luminous material is scarcely at all attacked by common atmospheric influences.

The action of light upon such substances may be compared to striking a bell. A momentary impulse excites it and causes the bell to vibrate and give forth a tone, which tone lasts for a certain length of time, continually growing feebler, until finally it ceases entirely. So, too, the phosphorescent body. Excited by a momentary illumination, it gives out a bright light at first, which grows weaker and weaker, until at last it can only be perceived by a perfectly quiet eye in the deepest darkness, and at last comes to rest. The after illumination of these substances under discussion lasts much longer than the after-sound of a bell, since the waves of light are much finer than the metallic vibrations of a ringing bell.

Most sources of light will excite phosphorescence in these substances, *e. g.*, a petroleum lamp, gaslight, and even a match. In these cases, of course the substance must be brought close to the source of light. It is excited especially by burning magnesium wire and by the electric light, but daylight is the best. Since water does not affect this substance, and since its luminosity is not due to oxidation and hence does not need the presence of atmospheric air, it will give light under water.

An alcohol lamp flame colored yellow by common salt will not excite it, but if the alcohol flame is colored blue by copper it will. In the sun's rays, those which lie in the violet and ultra-violet are the most energetic, and they decrease in power toward the yellow. It is remarkable how the yellow and red rays destroy the effect of the opposing violet rays by extinguishing or considerably weakening the luminosity caused by these latter. Similar relations prevail when the substance is covered with colored glass. Dark blue glass, although it seems to considerably weaken the light, permits all the active rays to pass through, and at times, when daylight contains many of the red and yellow rays, a substance that has been covered with blue glass is more strongly excited than if exposed to pure daylight, because the blue glass prevents the extinguishing action of the red and yellow rays. If a surface that has been covered with phosphorscent paint is first excited and then one half covered with pasteboard and the other with yellow glass, the extinguishing effect of the latter will be very noticeable. The portion covered with pasteboard will continue luminous after that covered with glass is almost dark.

Heat has a peculiar effect upon the phosphorescent body after it has been isolated. It causes it to give a more intense light for a short time, but the luminosity is then of shorter duration than it otherwise would be. Heat acts here somewhat as it does on a magnet, driving out the active power, so that it requires to be recharged to set the power again in action.

It seems as if light bears the same relation to the phosphorescence of these bodies that electricity does to magnetism; hence the name of light-magnet would not be inappropriate.

The color of the light thrown out is independent of the color of the exciting rays—*i. e.*, a certain substance always glows with the same colored light whether it has been excited by a violet, blue, or colorless light. Neither does the color depend on the addition of certain metals, but seems to be the result of a definite molecular condition of the substance. The light emitted retains its color but a short time. No matter how prepared, they all get to be one color after awhile —that is, white (?).

The duration of luminosity is differently stated by different authors. According to Gaedicke's observation the best ones made at present time last nineteen hours; but it requires perfect darkness and an eye entirely at rest, like on waking in the morning, to detect the faint glimmer. The intensity of the light, like the sound of the bell, is greatest at first and then decreases more rapidly than it does afterward.

Its luminosity is instantly destroyed by chlorine gas, also by hydrochloric and nitric acid; more slowly by sulphuric acid. It is further destroyed by substances which darken its color, hence it cannot be mixed with varnishes that contain lead and blacken; iron is also injurious, because it rusts.

When used as a paint it is mixed with some adhesive substance like glue, and can then be mixed with oil, water or a light-colored varnish, and applied repeatedly to the object that is to be rendered luminous. It is well to prepare a white ground for it with chalk or zinc white mixed with a little copal, which may be dissolved in oil of turpentine.

THE ELECTRIC LIGHT IN DYEING WORKS.—It seems probable that the electric light will be largely employed in dyeing works, where also electricity may be employed for other purposes. At night the light permits the matching of colors as in daylight, and in daytime the current may be employed for electrochemical purposes.

New Publications.

Bi-Centennial Souvenier. Philadelphia: What it is. Philadelphia Insurance Guide. J. H. C. Whiting. Review Publishing and Printing Co., Philadelphia. 1882. Price, 50 cents.

In view of the great interest manifested in the bi-centennial celebration of the founding of our neighbor city, the above named pamphlet, which contains much that is of interest and value to Philadelphians, is a very timely publication.

Among the many interesting facts presented in this readable volume, is one that is new to us—namely, that Philadelphia was the birth-place of fire and marine insurance on this continent. A directory of insurance companies, agents and brokers, which forms part of the work, will be useful to all having business with insurance men. It contains, likewise, many facts respecting the chief features of interest in Philadelphia; its prominent buildings, railroads, etc., together with much instructive information and statistical facts relating to the manufacturing industries of the city. The statement is made that the industries of Philadelphia have been very greatly underestimated in the census of 1880, and reference is made to the fact that a semi-official collection of the manufacturing statistics of the city is now being made, which will establish the fact beyond peradventure.

How to Keep a Store. Embodying the Conclusions of more than Thirty Years' Experience in Merchandizing. By Samuel H. Terry. 12 mo. 406 pages, extra cloth. Price, $1.50. New York: Fowler & Wells, Publishers, 753 Broadway.

This is a work occupying a field peculiarly its own, as we know of no other publication on the general subject of retailing goods having been published. This volume considers the selection of a business; the choice of a locality; the buying of goods and the obtaining of credit; the examination, marking and arranging of goods; how to advertise; the employment and training of clerks; the qualifications of a salesman and the art of selling; replenishing stock; losses by fire, theft, neglect, etc.; closing out surplus of stock; keeping of accounts; co-partnerships, and what should be considered in forming them; the influences of social life; investment of the profits; insolvency; business qualifications, etc. Every storekeeper should own this work, and see that it is placed in the hands of his clerks if he would have them intelligent workers with him, and not mere machines or "counter-jumpers." It will be found useful to all business men.

The Miller, Millwright and Mill Furnisher. A Practical Treatise. Illustrated with Four Hundred Engravings. By Robert Grimshaw. New York: Howard Lockwood. 533 pp. royal 8vo. Price, $6.

The best comment upon the scope and extent of this cyclopædic work is the index of 23 closely printed double-column pages which precedes the subject matter. The latter is divided into 41 chapters, of which, with the exception of Nos. 2 and 3, the first 18 (embracing 253 pages) are devoted to general mill building, power and transmission, and the rest to flour milling especially.

The first chapter relates to mill construction and completion; chapters 2 and 3, to mill plans and milling diagrams; chapter 4, to the relative advantages of steam and water power, and the quantities required; the next four are devoted to water power; and Nos. 9 and 10 to steam boilers and engines. Following, come six on shafting, belting, driving chains, gearing, pulleys and wire ropes; No. 17 on friction and lubrication; and No. 18, on back-lash and side-pull, aptly conclude this portion of the work, which mostly interests the general mass of our readers.

Concerning these, it must be said that the wide range of the author's theoretical knowledge and practical experience in these lines, and his clear and exact way of putting facts, prepared us for a very valuable and reliable contribution to industrial literature; and such he has given us. Any mill builder and mill owner may, from these reprints of the author's note-books, obtain the benefits of a record of good practice and a warning against bad; and constructing engineers and erecting millwrights will find between this one pair of covers the nearest approach that has thus far been made in book-form to a succinct yet full statement of all the broad, general principles and important details, convenient for daily reference or special consultation.

From page 254, commencing with chapter 19, Mr. Grimshaw deals exclusively with flour milling, by all present methods. The chapter titles are as follows: Grain Cleaning; Wheat Drying and Heating; Granulation and Grinding; The Buhr Stone; Mounting the Buhrs; Various Millstone Dresses; Dressing the Buhrs; Operation of the Buhrs; Cooling the Chop; Attrition by Air Blast; Iron Disk Mills; Details of Different Types of Buhr Mills; Systems and Pressures; Details of Rollers and Frames; Middlings Machines; Bran Cleaning; Bolting; Elevating, Spouting and Conveying; Weighing, Testing, Packing, Branding and Storing; Changing and Altering Mills; Millwrighting; Composition and Structure of the Wheat Berry; Grain Destroyers, and Miscellaneous, the latter chapter including, among other things, memoranda as to the qualities of wheat, the cost of manufacturing flour and of wheat transportation, tables of the prices of wheat, and "problems and solutions."

That the author has firmly grasped the theories underlying modern milling, and acquainted himself with the countless details of their application, the last two hundred pages show. They are even more replete than the first portion of the book with hard facts, valuable suggestions, quiet hints, carefully weighed comparisons, and well chosen quotations. Without either traveling in old ruts, or being carried away by new and slightly tried theories, the author, while sufficiently proving his competence to judge for himself and advise others in such matters, has backed his statements by notes, memoranda and opinions from sources entitled to the highest respect.

This solid volume amply establishes Mr. Grimshaw's position in the front rank among authors who have preceded him on this subject.

OTHER PUBLICATIONS RECEIVED.

Reduction of Internal Taxes. Address by Hon. William D. Kelly before the New York Tariff Convention, November 29th, 1881.

Railway Communication between North and Central and South America. A Memorial on the subject to the Congress of the United States of America. By Hinton Rowan Helper.

The Tariff on Iron and Steel Justified by its Results. A paper laid before the Tariff Commission at Pittsburgh, October 10th, 1882, by James M. Swank, Secretary of the American Iron and Steel Association. Philadelphia: The American Iron and Steel Association, No. 261 South Fourth street.

This department is intended to furnish, for the benefit of all our readers, information on any subject of a scientific or technical character falling within the field of THE MANUFACTURER AND BUILDER. *Any of our readers possessing additional or more correct information than that which we give relating to the questions, are cordially invited to communicate it to us for publication. We also request that all questions or answers be written on separate pieces of paper, and addressed to the Editor.*

QUESTIONS.

(3118) REFINING GOLD AND SILVER FROM JEWELERS' WASTE.—Will you please give me the best method known for refining and separating gold and silver from jewelers' waste, filings, etc., and oblige.—E. M. W., Dover, Del.

(3119) THE PHLOGISTON HYPOTHESIS.—What is meant by the term "dephlogisticated"? In looking over a medical work printed in 1772, I met several times with the expression, referring to a dephlogisticated substance.—C. F. W., Salt Lake City, U. T.

(3120) INFLUENCE OF FORESTS ON CLIMATE.—Is it generally admitted that forests exercise an influence on climate?—W. W., Baltimore, Md.

(3121) PHILOSOPHY OF THE DIVINING ROD.—What is your explanation of the divining rod? I have heard, on what I regard as very reliable authority, some extraordinary stories of its wonderful efficacy in pointing to water in the hands of certain people who are endowed with the right qualifications to use it.—G. W. J., Lawrence, Kan.

(3122) PREPARING GINGER, LEMON AND VANILLA EXTRACTS.—Please inform me through your valuable monthly how Jamaica ginger, lemon and vanilla extracts are made.—M. J. D., Boston, Mass.

(3123) LAUNDRY BLUES.—Will you please inform me how laundry blue, in powder and liquid form, is made.—M. J. D., Boston, Mass.

(3124) POLISH FOR CLEANING AND FILLING OLD FURNITURE.—Can you give me a good receipt for a polish for cleaning, filling and polishing old furniture?—M. J. D., Boston, Mass.

(3125) KEY-HOLE SAWS.—Would not the so-called key-hole saw be much handier to use if its teeth were made to pitch towards the handle? It is awkward to have to push with a very flexible blade in cutting, and there is constant annoyance from buckling, and, if not cautiously used, even of breaking the blade.—R. K., Ticonderoga, N. Y.

(3126) BRITISH AND AMERICAN STEEL.—I have been told that the steel manufacture of the United States was larger than that of Great Britain. Will you please inform me through your Queries department if this is the fact, as I am inclined to doubt it.—A. J. P., Cleveland, O.

(3127) BOILING WATER IN A SIEVE.—I have somewheres read of the experiment of boiling water in a sieve, but cannot now recall the precise method of performing the experiment. Perhaps you can aid me.—G. R. S., New York City.

(3128) SEPARATING MICA FROM PLUMBAGO.—Do you know of any practical method of separating mica from plumbago?—C. D. R., King of Prussia, Pa.

(3129) SOLVENTS FOR CAOUTCHOUC.—What are the best solvents for caoutchouc?—F. D., Reading, Pa.

(3130) RAZOR PASTE.—Can you give me a receipt for a good razor paste?—B. F. M., Yonkers, N. Y.

(3131) BLUE PRINTS FROM TRACINGS.—Where can I get the apparatus for making blue prints from tracings? An early answer will greatly oblige.—W. H. G. E., Sunbury, Pa.

(3132) UNPLEASANT TASTE FROM NEW WOODEN VESSELS.—Is there any way of removing the disagreeable taste from new wooden vessels?—J. C., Cumberland, Md.

(3133) FLOWER BAROMETERS.—How are the so-called "flower barometers" made?—J. W. J., Pittsburgh, Pa.

(3134) TO BANISH ANTS.—We are greatly troubled at home with ants that infest the closets. Can you give an effectual receipt for banishing them?—M. V. C., Newark, N. J.

REPLIES.

HORSE-POWER FORMULA.—In further reply to inquiries on this subject that we have answered from time to time, we add the following remarks from Mr. Grimshaw's lately published work on "Milling." A very neat little formula, easily remembered, for computing the horse-power of steam engine, is that given by Prof. William D. Marks, of the University of Pennsylvania. The rule, of course, refers only to indicated horse-hower. Let P represent the mean pressure of steam on the piston head per square *inch, in pounds;* L, the length of stroke in feet; A, the area of the piston head in *square inches;* and N, the number of *strokes* (*i. e.*, twice the number of revolutions of the crank) per minute; then (HP) the horse-power will be equal to

$$\frac{PLAN}{33{,}000}$$

This formula is sensible, because the letters spell a familiar word. Those formulas which give a lot of Greek letters, bother the average mechanic. It must be remembered that it will not do to be wild in assuming the unit of measurement, as the formula would cipher out different things with feet from the answer with inches. From this very simple formula may be found any one of the five elements, if the other four are given. In this we have PLAN to find horse-power; but we may take advantage of the same relations to find only one of the others. Thus, if we have given the horse-power required, and know the length of stroke of our engine, its diameter or area of piston, and the number of strokes necessary for the engine to run, in order to give certain machines in the mill a certain speed, we may find pressure needed to get this horse-power by the formula

$$P=\frac{33{,}000}{LAN}(HP)$$

From the same figures the length of stroke is equal to

$$\frac{33{,}000}{PAN}(HP);$$

the area equal to $\frac{33{,}000\ (HP)}{PLN}$;

and having given the steam pressure, the length of stroke, and the piston diameter or area, we can find the number of strokes needed to get a given horse-power, by

$$\frac{33{,}000\ (HP)}{PLA}$$

In such formula, it is the custom not to write the sign of multiplication, it being understood that two letters written together, as AB, in a formula, are to be multiplied together. Thus, PLAN means P times L times A times N; HP denotes a single quantity—horse-power. There are other considerations, such as clearance, or waste of space in cylinder and in steam passages; throttling, or wire-drawing (reduction of pressure in cylinder by small and tortuous passages); back pressure, etc., which modify the above figures.

(3118) REFINING GOLD AND SILVER FROM JEWELERS' WASTE.—In the case named by this inquirer, the gold and silver are alloyed, or mixed with copper, brass, iron, etc. The waste is first burned in an iron pan, to destroy any organic matter that may be present. It is then intimately mixed with a small quantity of dry carbonate of potassium (or of sodium), and melted in a crucible. When fusion is complete, a few crystals of nitrate of potassium (saltpeter) are thrown into the crucible from time to time, in order to oxidize and remove from the gold and silver any copper and iron there may be present. In doing this, care must be taken not to add too much saltpeter at a time, as otherwise in case any organic matter is present yet, the flux may swell up and overflow the melting pot, carrying some of the metal with it. When any tendency of this kind is observed, it can be corrected by throwing into the pot a small quantity of common salt, which will check the boiling. When the oxidation of the base metals appears to be complete, the pot is removed from the fire and allowed to cool off. It is then broken at the base with a hammer, and a "button" of metal containing the gold and silver will be found, which must be removed, introduced into another crucible, and again melted, this time with the addition of enough silver to equal two or three times the weight of the gold, unless the percentage of silver present is already large enough, when the addition of more silver will be unnecessary. Dry carbonate of potassium (or sodium) or borax is used as a flux. When melted, the metal is poured into a vessel of cold water, the latter being briskly stirred during the operation, and having some sticks or straws floating on the surface, for the purpose of assisting the granulation. The metal, now in small grains, must be carefully collected, and to insure that there is no waste in the subsequent operations, it should be dried and weighed. The metallic granules are now put into a suitable glass flask, covered with dilute nitric acid (1 acid to 2 water), and exposed to gentle heat for several hours. Towards the end of this period it may be well to place the flask on the sand bath for a while to insure the complete solution of the silver. The solution (containing silver) is now decanted off from the gold, which will be left at the bottom of the flask as a brownish powder, and, if desired for greater accuracy, the gold residue may be again treated with nitric acid, heated as before, adding the last liquid to the first. The acid must be thoroughly washed off from the gold, that no silver may remain with it, and the wash water is added to the silver solution in the second flask. The gold powder is now pure, and only requires to be melted down to a button with soda or potash in a crucible. The silver may now be precipitated from its solution by means of strips of copper or zinc, and subsequently collected, dried and melted down to a button; or it may be precipitated as chloride of silver by means of muriatic acid or a solution of common salt. In this case the solution should be boiling, to insure the rapid subsidence of the curdy silver precipitate. The silver is all thrown down when the addition of a drop of acid or salt solution causes no cloudiness in the clear supernatent liquid. The precipitate should now be decanted several times with boiling water, then removed to a porcelain dish and dried over the water bath, then mixed with dry soda or potash and melted to a button in a crucible.

(3119) THE PHLOGISTON HYPOTHESIS.—The term "dephlogisticated" has reference to an ingenious hypothesis respecting the nature of combustion, which was generally accepted by the chemists of the last half of the eighteenth century. It originated with Stahl, an eminent Swedish chemist. His idea was that all combustible bodies contained a combustible principle, or principle of inflammability, which they have in common; and to this supposed principle he attached the name "phlogiston." He adopted, also, the ancient idea that the process of combustion was a destructive one, and that, while burning, a something separates from the combustible—that this something appears to us as flame. He assumed that the more readily and energetically a body was consumed the more phlogiston it contained; that when combustible bodies were heated to a certain point, they began to yield up their phlogiston, and continued to burn so long as they had any phlogiston to give up, when they were reduced to the condition of incombustibility, or, in other words, dephlogisticated. The process of burning on this hypothesis, therefore, dephlogistication; its opposite, phlogistication. By bringing a burned (dephlogisticated) body in proper relations with another having an abundance of phlogiston, it could generally be induced to take up its proper or normal quantity of this hypothetical material, and thus be returned again to the condition in which it was before burning; and it was, therefore, possible to repeat the processes of phlogistication and dephlogistication without limitation. According to the teachings of this hypothesis, a body in its normal condition was presumed to consist of the ash (calx) which remained behind after burning, and the phlogiston which had separated with the phenomenon of flame. If, therefore, phlogiston was a material substance, the body must of necessity weigh less after burning than before. It was discovered, however, that combustion was accompanied by a gain in weight. For a time, nevertheless, the phlogistonists endeavored to reconcile this awkward fact to their favorite hypothesis on the curious but highly ingenious assumption that phlogiston (the existence of which, by the way, they had never succeeded in demonstrating by isolating it) was a substance endowed with so exalted an affinity for the moon and other celestial bodies, that instead of being possessed of weight, it was possessed of levity; so that, therefore, in being separated from its state of combustion by combustion, it left the body after its departure really heavier than it was before. The discovery of oxygen by Priestly and Scheele towards the close of the last century, and its proper relations to combustion, which were shortly thereafter demonstrated by Lavoisier gave the chemical world a clear insight into the nature of combustion, and the old phlogiston hypothesis was, therefore, speedily abandoned. It is now only remembered as a curious instance of a mistaken hypothesis that once held universal sway in the chemical world. It is a singular fact, however, that Priestly, whose discovery of oxygen laid the foundations for the subsequent destruction of the phlogiston hypothesis, steadfastly refused to accept its first and most brilliant development. He died, as he had lived, a devoted phlogistonist.

(3120) INFLUENCE OF FORESTS ON CLIMATE.—It is undoubtedly true that the presence or absence of woodland exercises a most pronounced influence on climate, and the fact is no longer disputed. This correspondent is advised to consult Marsh's "Man and Nature" and Dr. Felix Oswald in the *Popular Science Monthly*, for excellent disquisitions on this topic. An article in the Boston *Journal of Chemistry* gives an excellent summary of the subject, from which we quote the following: "Many rivers have totally disappeared, or have become reduced to mere

streams, by an irrational and heinous felling of the forests. In the northeast of Germany, the Narp and the Gold rivers exist only in name. The classic lands of antiquity are rich in sad lessons of deforestation. The springs and brooks of Palestine are dry, and the fruitfulness of the land has disappeared. The Jordan is four feet lower than it was at the beginning of our era. Greece and Spain suffer severely today from the effects of destroying their forests. Many parts of the kingdom of Würtemberg have been rendered almost barren by the felling of the trees. In Hungary the periodically returning drouth [and, the writer might have added, inundations.—*Ed. M. & B.*] is universally attributed to the extermination of the forests. We attribute the present unfruitfulness of Asia Minor and Greece [the entire country bordering on the Mediterranean, and which was once the garden spot of the world, might properly have been included. —*Ed. M. & B.*] to the destruction of the woods; steppes, ruins and tombs have taken the place of what was once the highest culture. Sardinia and Sicily were once the granaries of Italy, but have long since lost the fruitfulness that was once the song of their poets. On the other hand, man may improve the condition of the land in which he lives, more slowly indeed, but as certainly, by cultivating and preserving the forests. In earlier years, reliable authorities have told us that in the delta of Upper Egypt there were only five or six days of rain during the year, but that since the time when Mehemet Ali caused some 20,000,000 trees to be planted, the number of days of rain in the year has increased to forty-five or forty-six. The Suez canal has produced remarkable results. Ismailia is built on what was once a sandy desert, but since the ground has become saturated with the canal water, trees, bushes and other plants have sprung up as if by magic, and with the reappearance of the vegetation the climate has changed. Ten years ago rain was unknown in these regions, while now it is common." By consulting the works above named, many other, and more striking, facts bearing on this subject will be met.

(3121) Philosophy of the Divining Rod.—Dr. Carpenter's explanation of the apparent mystery of the divining rod appears to us to be a very satisfactory and scientific one. It is, in brief, as follows: The rod is a forked twig shaped like the letter Y, hazel being usually preferred; and the diviner walks over the ground to be explored, firmly grasping its two prongs, with his hands held in such a position that its stem points forward. After a time, the end of the stem points downwards, often, it is said, with a writhing or struggling motion, especially when the fork is tightly grasped; and sometimes it even turns backwards, so as to point toward instead of away from the body of the diviner. Now, there is a very large body of apparently reliable testimony, that when the ground has been opened in situations thus indicated, either water springs or metallic veins have been found beneath; and it is quite certain that the existence of such a power is a matter of unquestioning faith on the part of large numbers of intelligent persons who have witnessed what they believe to have been its genuine manifestations. This subject was, however, carefully inquired into more than forty years ago by MM. Chevreul and Biot, and their experimental conclusions anticipated those to which I was myself led, in ignorance of them, by physiological reasoning. They found that the forked twig cannot be grasped firmly for a quarter of an hour or more, in the regulation position, without the induction of a state of muscular tension, which at length discharges itself in movement; and this acts on the prongs of the fork in such a manner as to cause its stem to point downward, upward or to one side. The occasion of this discharge, and the direction of the movement are greatly influenced, like the oscillation of bodies suspended from the finger, by *expectancy* on the part of the operator; so that if he has any suspicion or surmise as to the whereabouts of the object of his search, an involuntary and unconscious action of his muscles causes the point of the rod to dip over it." This strikes us as being the most rational way of accounting for this peculiar fact—for fact it unquestionably is—and deprives it at once of all the elements of mystery. Like all other mysteries, the accident of one or two lucky hits impresses the credulous mind very forcibly, hence the widespread belief in the magic qualities of the divining rod. The instances of failure are forgotten, which is fortunate, as they would probably be too great for enumeration.

(3122) Preparing Ginger, Lemon and Vanilla Extracts. —The following recipes are highly recommended: *Essence of Ginger.*—1. Bruised, unbleached Jamaica ginger, 12 pounds; rectified spirits of wine, 2½ gallons; keep in a warm place 14 days, press, strain and reduce by distillation to 1 gallon, cool and filter. This procedure is said to produce a very superior article. It is at once inexpensive and easily performed, as the spirit distilled off may be used again. Two ounces of this essence are regarded as equivalent to three ounces of the finest ginger. 2. Ginger and animal charcoal, both in coarse powder, equal parts; add enough rectified spirits of wine to perfectly moisten them, and after 24 hours put this mass into a percolator, return the first runnings two or three times, then change the receiver and pour on spirit gradually as required, and at intervals, until as much essence is obtained as there was ginger employed. The quality of this product is said to be excellent. The mass remaining in the percolator may be treated with fresh spirit until exhausted, and the tincture so obtained may be advantageously employed, instead of spirit, in making more essence with fresh ginger. The last portion of spirit in the mass may be obtained by adding a little water. *Lemon Extract.*—Expose 4 ounces of the exterior rind of lemons in the air until partially dry, then bruise in a mortar; add to the mass 2 quarts of deodorized alcohol of 95°, and agitate until the color is extracted; then add 6 ounces fresh oil of lemon. If it does not become clear immediately, let it stand for a day or two, agitating occasionally; then filter. *Extract of Vanilla.*—Cut 1 ounce of vanilla into small pieces, and triturate in a mortar, with 2 ounces of sugar, to a coarse powder. Put it into a percolator, pour on it diluted alcohol until 1 pint has run through; then mix with 1 pint of syrup. A more powerful essence is prepared as follows: Take ½ pound (avoirdupois) of the finest vanilla and 1 quart of rectified spirit. Introduce them into a tin can with nicely rounded neck, into which a cork may be tightly fitted, and then securely tied over with a wet bladder. This should then be placed where it will be warmed by the sun, and allowed to remain for three or four weeks. The addition of a small quantity of liquid ammonia is recommended, to increase the solvent power of the spirit, and is said also to increase the fragrance of the essence. Then decant and press, or filter. This forms a very superior essence, and is the kind sold by wholesale druggists at high prices. In preparing it, the vanilla should be cut small with a sharp knife, or, still better, rubbed down with a little powdered glass, sand or lump sugar.

(3123) Laundry Blues.—Take the ordinary cake blue, which consists of indigo and starch, and powder to make dry laundry blue. For soluble blues, several recipes are given below: Take 1 ounce of soft Prussian blue, powder it, put in a bottle with 1 quart of clean rain-water, and add ¼ ounce of oxalic acid. Or, mix 4 parts of Chinese blue, 1 of Turnbull's blue, and 1 of oxalic acid; gradually add boiling water until the whole is dissolved, then add lastly 4 parts of sulphate of indigo. The latter is made by treating 1 part of indigo with 4 of sulphuric acid, and neutralizing with carbonate of ammonia.

(3124) Polish for Cleaning and Filling Old Furniture. —The following preparation will be found useful for this purpose, in which operation, it should be observed, it is of great importance to make the coating as thin as possible. Put two ounces of white and yellow wax over a moderate fire, in a clean vessel, and when quite melted add 4 ounces of best spirits of turpentine; stir the whole until it is entirely cool, when it is fit to use. The oil soon penetrates the pores of the wood, brings out its color, causes the wax to adhere better, and produces a luster equal to that of varnish. The polish may be renewed at any time by rubbing with a piece of fine cork. Or, bees'-wax, ½ pound; alkanet root, ¼ ounce; melt together in a suitable vessel until the wax is well colored; then add linseed oil and spirits of turpentine, ½ gill of each, and strain. If wanted pale, the alkanet root may be omitted. Or, the furniture may first be cleaned with a mixture made as follows: Take a quart of stale beer or vinegar, put into it a handful of common salt and about a table-spoonful of muriatic acid, and boil for 15 minutes. It may be kept in a bottle, and warmed when wanted for use. First wash the furniture with hot (soft) water to get the dirt off; wash it carefully with the above mixture, then apply the paste as above directed. Or use a paste prepared as follows: Take 3 ounces of white wax, ½ ounce of castile soap, and 1 gill of turpentine; shave the wax and soap very fine, and put the wax to the turpentine; then boil the soap in a gill of water, and add to the wax and turpentine.

(3125) Key-Hole Saws.—The same suggestion that is offered by this inquirer has already been suggested by others. His objection to the key-hole saw is sound. The earliest allusion to its awkwardness that we know of, we happened to have observed in the *Polytechnic Review*, an excellent technical journal now no longer published. One of the editors of that journal made, in reference to this instrument, the following statements: Did it never occur to the average carpenter, or the average saw-maker, that of all the things that *do* work the wrong way, the key-hole saw is one of the most marked? and that its present construction and use are inexcusable? The key-hole saw, as we know it, is excessively tapered, and very flexible laterally, and generally none too elastic; and yet its teeth pitch *from* the handle, so as to necessitate a thrust cut with its limber blade; whereas they ought to pitch *towards* the handle, to be used with a pulling cut, so that the strongest pull would cut the best and leave the blade straight. The teeth are too small to allow of M or other double-cut teeth, hence our suggestion that the scraping teeth might be reversed with great advantage.

(3126) British and American Steel.—In the figures of total production of steel, the United States and Great Britain stand very near to each other. The larger quantity, however, is produced by Great Britain. This country has, during the last two or three years, made wonderful progress in this and in all other branches of the iron trade. In the items of crucible steel and open-hearth steel, the British lead the United States considerably; but in the production of Bessemer steel the United States, in 1880, led Great Britain by 29,880 tons, though in 1881 the latter country regained her lead by an excess of 67,472 tons. From the unprecedented rapidity with which our iron and steel industries are developing, however, we risk little in saying that, unless some untoward event should occur—a financial crisis, or something of a like unfortunate character, to put a check on our present prosperity—within ten years the United States will be the leading producer of iron and steel.

(3127) Boiling Water in a Sieve.—There are numerous ways in which this curious experiment may be performed. One of the simplest is the following: If the open mouth of a glass bell-jar, of any diameter from 10 to 20 inches, be closed by means of a piece of coarse muslin, and then depressed into a vessel of water, the water may be drawn up into the bell-jar by aspiration through a tube attached to an orifice at the top. On being raised out of the water, the jar will be found to retain its contents, the muslin meshes performing the functions of capillary tubes. At each of the meshes there is a well marked meniscus. A Bunsen burner may now be lighted and placed beneath the water, the temperature of which may be raised even to boiling without any of its contents escaping through the meshes. It will fall, however, if the boiling is too violent.

(3128) Separating Mica from Plumbago.—From what we can learn from the letter which accompanies this inquiry, considerable micaceous plumbago occurs in Bucks county, Pennsylvania, some of which is worked profitably; but the product, as it cannot be freed from the mica, is unfitted for many purposes for which only high grade graphite is adapted. The problem of separating mica and plumbago appears, thus far, to have been impossible to solve, except to a very limited extent. Separation by mechanical means can only be practically accomplished where the mica is segregated in large crystals; but if the mica is fine grained and completely interfoliated with the plumbago, as is usually the case, such separation becomes practically impossible. The two minerals resemble each other so closely in their physical properties, having a similar laminated crystalline structure, and so nearly the same specific gravity, that separation by washing and floating is out of the question. Separation by chemical means is equally impracticable, as such an operation, though possible, would be very difficult and expensive.

(3129) Solvents for Caoutchouc.—The best solvent for caoutchouc is said to be caoutchoucine, which is obtained by subjecting rubber to dry distillation. Other well-known solvents are chloroform, carbon di-sulphide, rosin oil, coal naphthas, rectified spirits of turpentine, tar, the oils of lavender, sassafras and rosemary, and benzine (petroleum spirit). Pure oil of turpentine dissolves 49 per cent of caoutchouc. A mixture of 6 to 8 per cent of absolute alcohol and 100 of carbon disulphide is said to be an excellent solvent. Sulphuric ether, which alone is a poor solvent, dissolves more readily if about 5 per cent of absolute alcohol is added. Hot alcohol dissolves out about 4.5 per cent of a soft resin. It is sparingly soluble in hot fusel oil; readily at a gentle heat in melted hog's lard, or in very hot whale oil. After swelling up in oil of turpentine, or in naphtha, it is soluble in hot linseed oil.

(3130) Razor Paste.—Mix fine emery intimately with fat and wax until the proper consistency is obtained in the paste, and then rub it well into the leather strap. Prepare the emery by pounding the rather coarse material in a mortar, throwing the material into a vessel of water, and stirring well. Immediately after the large particles have sunk, pour off the supernatent liquid into an evaporating dish, and evaporate off the water. Another receipt is: Emery, reduced to an impalpable powder, 2 parts; spermaceti ointment, 1 part; mix together and rub it over the strop. Another is: Jewelers' rouge, blacklead and suet, equal parts; mix and rub it over the strop.

(3131) Blue Prints from Tracings.—Many of the dealers in photographers' materials and supplies furnish materials and full instructions in the art of making "blue prints." We append several addresses of parties in New York and Philadelphia: E. & H. T. Anthony & Co., 591 Broadway, and Scoville Manufacturing Co., 419 and 421 Broome street, New York; Thos. M'Collin, 524 Arch street, and James W. Queen & Co., 924 Chestnut street, Philadelphia.

(3132) Unpleasant Taste from New Wooden Vessels.— This is often difficult to do. The simplest plan, which will often be found effective, is to scald them thoroughly several times with boiling water; then dissolve some pearlash or soda in luke-warm water, adding a little lime to it, and wash the inside of the vessels well with the solution. Afterwards scald them again thoroughly several times with boiling water as before.

(3133) Flower Barometers.—Artificial flowers are moistened with a solution of chloride of cobalt. When exposed to the sunlight and dry air the leaves become a deep blue; when the air becomes saturated with moisture they assume a pinkish hue. All the intermediate tints are given. The same idea has been applied in many different ways, to produce novel scientific toys.

(3134) To Banish Ants.—An old remedy for banishing ants, which we believe will be found very effectual, is to place a small piece of gum camphor, wrapped in paper or a cotton rag, in the place infested with them.